農業研究

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PHYLOGENETIC DIFFERENTIATION OF THE CULTIVATED RICE PLANT

I. Varietal variations of various characters.

By

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Introduction

The rice plant, distributing from tropical to temperate regions, has been once believed to be composed of two subspecies, Indica and Japonica (9) (or Shen and Kêng in China), and comparative studies of varieties have been carried out on the ground of this classification. Terao and Mizushima (38, 39) pointed out, however, that the interrelation of varieties in hybrid sterility was too complicated to establish these two subspecies, while three or several variety-groups were detectable indistinctly. On the other hand, Matsuo (18) stated, after observing geographical variation of various characters, that the varieties of rice plant were to be divided into three types, A, B, and C. The present problem, how to classify the rice plant, seems to be of some interest for every-body who are concerned with the breeding of the rice plant; this may be due to the respect that an understanding of the genetical construction of rice plant through the study of the present problem is of essential importance for laying a foundation of the breeding.

In order to throw a light on this problem, the authors have dealt with varietal variations of various morphological, physiological, and ecological characters, intervarietal hybrid sterility, intervarietal genic differences, and other respects in a series of studies. Among these works, some observations on the variation of several characters among the varieties of various districts of Eastern Asia will be repoted in the present paper.

Variations of diverse kinds of characters are found among the varieties of rice plant. When numerous varieties were observed with regard to various characters, how to arrange the results of observation would be in itself a subject for consideration. And this may be considered according to a general conception of evolution as follows: A number of genic changes being existent in a species of living thing, an enormous number of gene combinations among them would be possible. A part of them may be inviable and may not be realized, but the rest, adaptable to some extent, will still give rise to an astronomical figure in number. Therefore, in the field of possible gene combinations only a part will be realized to form existent varieties. (If all were existed, cross breeding would lose its reason.) Whereas, if the gene combinations occupied by existent varieties were of such a nature as picked out randomly from the

field of possible combinations and had no relation inter se, no phylogenetical differentiation would be traceable in that population of varieties. In such a case, regarding to phenotypes, varietal variations of the characters as influenced by a number of genes all would be of continuous shape, and various character combinations all would be existent in essentially equal frequencies.

However, the above mentioned situation may not be the usual case. Several intra-similar and inter-dissimilar groups may be formed within a species on account of the development of mutually isolated populations and other factors exerting influence on them, and thus definite kinds of gene combinations may be raised in frequency. In the phenotype, there might be expected such phenomena as discontinuous intervarietal variations in characters as influenced by a number of genes and a definite tendency in character combinations.

Though the genic changes underlying among various varieties may be too difficult to analyse thoroughly, it will be conceivable, according to the above mentioned considerations, that observations of various characters with reference to the discontinuity of varietal variation and the tendency of character combination will lead to a speculation of phylogenetical differentiation in the genotype.

The results of observations in the present study were arranged along the above mentioned line; and came to such a conclusion that the varieties of rice plant are differentiated in the direction of two variety-groups. The two variety-groups were named "Continental" and "Insular" with a view to express their geographical distribution. Insular variety-group seemed to be divided further into two minor groups which were named as "Tropical" and "Temperate".

The studies reported in the present paper were carried out from 1943 to 1950 in the former Taichung Agricultural College and Taiwan Provincial College of Agriculture. The authors are indebted to the college authorities for their kind support, and also to the staffs and students of the laboratory for their painful work. Further, the authors express their hearty thanks to Dr. Eikichi Iso, consulter of the Agricultural Department of Taiwan Provincial Government, for his valuable advices and encouragement.

Materials

Varieties of the rice plant about eight hundred in total number were collected from 1941 to 1943 from various districts of Eastern Asia, i. e. Formosa, Indochina, Siam, India, Chinese Continent, Hai-Nan Island, Philippine, Celebes, Indonesia (Sunda Islands), and Japan. A greater part of Formosan varieties and some part of Japanese ones were spared by the Agricultural Research Institute of the Government of Formosa, the other part of Japanese varieties were spared by the Ohara Institute for Agricultural Research (Kurashiki, Japan), and Indian varieties were spared either by Plant Breeding Institute of the former Taihoku Imperial University or by the Coimbatore Agricultural Experimental Station, India. Varieties of other districts were collected at different opportunities

from agricultural institutions or farmers of respective districts. For the convenience of designating each of these varieties, they were numbered, and the numbers were used instead of the local names.

These varieties were inbred repeatedly in an experimental garden on a certain system which was essentially equal to pedigree selection, but was aimed only to gain pure lines and without a definite direction of selection. Some one hundred and twenty varieties were selected nearly randomly from the whole varieties aud determined as "representative varieties". A major part of the preserved varieties or these "representative varieties" were used for the observation of various characters.

There were prepared, as the materials of observation, fully enriched seeds selected from those harvested at proper stages and stored in a desiccator with calsium chloride. The method of observation of each character will be described in the paragraphs of observation results.

It was generally attended to avoid any pre-conception such as Indica aud Japonica types.

Observation Results

(1) Phenol Reaction

Varietal difference in phenol reaction of the glumes of rice seed was pointed out first by Kondo and Kasahara (14) and Kuwatuska (16). Since then, it has been believed that so-called Indica type shows a positive reaction while Japonica type does not (36). The authors observed the phenol reaction of almost all of the preserved varieties by the following method: to soak ten seeds of each variety in 1.5% phenol solution for two to three hours, then dry them gradually over a night, and observe the coloration being whether positive (plus) or negative (minus) and, if positive, the depth of color. (By this method, a same sample always showed a same reaction; changing the concentration of phenol solution or the time of soaking, the depth of color in positively reacting varieties changed, but the change between positive and negative was never seen.)

Table 1. Varietal variation of phenol reaction.

Districts	Reaction +				Reaction	Total num.
	Deep brown	Sepia	Light brown	in total	—	of vars.
Indochina	21	31	7	59	8	67
India & Siam	23	25	13	61	6	67
Formosa (plain part)	29	24	7	60	2 *	62
South China	1	23	11	35	8	43
West China	2	17	2	21	3	24
Central China	3	18	3	24	24	48
North China	—	1	1	2	7	9
Formosa (mountain part)	—	9	11	20	41	61

Hai-Nan Island	—	7	7	14	18	32
Philippine	24	15	7	46	24	70
Celebes	13	17	5	35	40	75
Sunda Islands	6	14	6	26	43	69
Japan (lowland vars.)	—	—	—	—	36	36
Japan (upland vars.)	1	14	—	15	7	22
Total	123	215	80	418	267	635

* Horai varieties

The frequency of varieties showing positive and negative reactions among the varieties of various districts is given in Table 1. Varieties showing positive reaction were predominant in Indochina, India, Southern China and Formosa (native varieties of plain part); while, varieties showing negative reaction were in Sunda Islands, Celebes, Philippine, Hai-Nan Island, Mountain part of Formosa and Northern China, and lowland varieties of Japan all were of negative reaction. It may be said in short words that the varieties showing positive and negative reactions distribute mainly over the continent of Eastern Asia and the islands of western Pacific respectively.

As regards the inheritance of phenol reaction, Morinaga et al (21) have demonstrated that the positive reaction is a single dominant over the negative reaction. Having examined its genetical behavior with a relatively large number of hybrids, the authors also came to the same conclusion without any exception, and recognized further that the segregation ratio was affected little by intervarietal hybrid sterility. Some example of the segregation is given in Table 2, but the details will be reported in another paper.

Table 2. Examples of segregation ratio of phenol reaction in F_2s.

Crosses	Obs. Num. +	Obs. Num. —	Exp. Num. +	Exp. Num. —	X^2	% of normal pollen (F_1)
1 × 325	127	38	123.75	41.25	0.330	85
1 × 521	101	28	96.75	32.25	0.743	58
1 × 703	127	42	126.75	42.25	0.002	89
108 × 325	136	42	133.5	44.5	0.187	95
108 × 703	110	38	111.0	37.0	0.036	62
108 × 647	98	32	97.5	32.5	0.010	87
219 × 108	80	29	81.75	27.25	0.112	65
414 × 219	188	63	188.25	62.75	0.013	63
414 × 325	167	59	169.5	56.5	0.147	66
521 × 1	93	30	92.25	30.75	0.024	58

As regards the physiological cause of phenol reaction, no more has been known than a speclation of some enzyme taking part in the reaction (11); at any rate, it seems difficult to assume that this character has some important rôle physiologically

or ecologically. It was found, however, that the varieties showing positive and negative reactions were different in various characters. This would be, as discussed later, due to the preponderance of definite character combinations among the varieties. For the sake of expressing this tendency, the relation of phenol reaction to the variation of each character was observed as given below.

(2) The degree of destruction of endosperm by caustic potash

Kondo and Kasahara (12,13) pointed out that the degree of destruction of rice endosperm in ca. 2% solution of caustic potash (KOH) was proportional to the quantity of the drug absorbed, and heavily destructed rice was generally viscous and nice in taste. In the present study, a larger part of the preserved varieties were observed on this character by the following method: Ten grains were cut transversally at the middle part and were soaked in 1.8% or 2.1% solution of KOH for twenty-four hours at the room temperature, 27°-30°C. The degrees of destruction were graded as the following seven classes on which index-numbers, 0-6, were set respectively: (0) unchanged, (1) cut surface being swelled, (2) cut surface being destructed and the whole endosperm being swelled, (3) endosperm being destructed to show irregular shape, (4) destructed as if a piece of cotton, (5) dissolved and semi-transparent, and (6) nearly transparent. The degree of destruction of a variety was given by the average of the index-numbers on ten grains.

Variation of the degree of destruction among the varieties of various districts is given in Table 3. The variation seemed to be continuous; the varieties positive in phenol reaction were slight in the degree of destruction generally, while those of negative reaction varied on a wide range. The geographical variation was somewhat similar in the tendency to that of phenol reaction; the varieties as destructed heavily by caustic potash were found mostly in the temperate regions, such as Japan and Northern China, and partially in Celebes, Sunda Islands and other district.

Table 3. Variatal variation of the degree of destruction of endosperm in alkali-test.

Districts	Degree of destuction ※							Total num. of vars.
	0	1	2	3	4	5	6	
Indochina	—	15	37	15	2	1	—	70
India & Siam	—	29	18	6	—	1	—	54
Formosa (plain part)	—	35	8	6 *	—	2 *	—	51
South China	—	29	9	2	3	—	—	43
West China	—	5	18	1	—	—	—	24
Central China	—	15	16	4	7	5	—	47
North China	—	3	—	1	5	1	—	10
Formosa (mountain part)	1	10	2	28	9	3	—	53
Hai-Nan Island	—	6	8	8	4	—	—	26
Philippine	—	51	13	6	1	2	—	73
Celebes	—	22	29	6	4	10	2	73

Sunda Islands	—	30	13	5	4	—	—	57
Japan (lowland vars.)	—	—	—	10	17	9	—	36
Japan (upland vars.)	—	—	1	2	13	6	—	22
Vars. of phenol reaction +	—	198	128	43	17	8	—	394
Vars. of phenol reaction —	1	52	49	57	52	32	2	245
Total	1	250	177	100	69	40	2	639

* Horai Varieties
※ Explanation in text

The genetical behavior of this character is unknown, whereas it was found, in the second and third generations of the hybrids between the varieties showing slight destuction and those showing heavy destruction, that a major part of the segregates was intermediate in the degree of destruction. Considering from this point, this character is likely to be affected by a number of genes.

(3) Pottasium chlorate resistance

The resistance of plants to pottasium chlorate ($KC10_3$) is different with species or variety. Yamasaki (42,43), having studied its variation among Japanese rice varieties, demonstrated such a relation that the varieties resistant to $KC10_3$ tended to be resistant to drought. The present study pointed out, however, as given below, that the varieties resistant to $KC10_3$ (corresponding seemingly to so-called Japonica type) were not resistant to the lack of available water in soil.

Table 4. (a) Relation between the concentration of $KClO_3$ and the degree of injury.

Conc. in % \ Days after treatment	60 (R. T. S. 23)			421 (P. T. B. 8)			504 (Taichung no. 65)			563 (Kinoshita mochi)		
	3	5	7	3	5	7	3	5	7	3	5	7
0.0125	0	0.5	0.6	0	0	0.1	—	—	—	—	—	—
0.025	0.4	0.8	0.9	0.2	0.5	0.7	—	—	—	—	—	—
0.05	0.4	1.0	1.7	0.2	0.5	0.8	—	—	—	—	—	—
0.1	0.5	1.2	1.8	0.6	1.0	1.4	0	0.3	0.6	—	—	—
0.2	1.0	1.8	2.1	0.7	1.1	1.5	0.1	0.5	0.5	—	—	—
0.5	—	—	—	—	—	—	0.1	0.4	0.7	0	0.3	0.3
1.0	—	—	—	—	—	—	0.5	0.7	0.8	0.2	0.6	0.7
2.0	—	—	—	—	—	—	0.6	0.7	0.8	0.1	0.6	0.6
4.0	—	—	—	—	—	—	1.7	2.4	2.6	0.9	1.7	2.0

(b) Relation between the number of days from water soaking of seeds to the treatment and the degree of injury.

Days	60 0.05 %	421 0.2 %	504 1 %	563 4 %
1	0	0	0	0
2	0.7	0	0.2	0
3	1.7	1.3	0.7	1.0
4	1.7	1.3	0.8	1.6
5	1.7	1.9	0.8	1.7
6	1.9	1.4	0.5	1.2
7	1.6	1.5	0.9	1.7

Index-numbers of the degree of injury:

0 ·· without visible injury,

1 ·· growth being delayed and contaminated partially,

2 ·· growth being inhibited and contaminated wholly,

3 ·· killed and rotted.

(c) Relation between the length of treatment and the degree of injury.

Hours	60 0.1%	421 0.1%	504 2.0%	563 2.0%
1	0.1	0	0.3	0
4	1.3	0	0.4	0.2
7	2.0	0.5	—	0.1
24	2.5	1.1	0.8	0.4
48	2.5	2.7	—	0.5
72	—	—	2.5	—

Varieties:

60 ·· R. T. S. 23 (Indochina) 421 ·· P. T. B. 8 (India)

504 ·· Taichung no. 65 (Formosa) 563 ·· Kinoshita-mochi (Japan)

A larger part of the preserved varieties were observed on this character. At first, with a view to find out a proper method of observation, several preliminary experiments were carried out with reference to the expression of resistance in seedlings. And it was found that (1) the injury of pottasium chlorate such as the inhibition of growth and contamination appeared gradually after the treatment with the lapse of time, (2) a definite degree of injury inherent to variety showed itself when the seedlings were treated on the fourth or later days after the water soaking of seed, for every varieties being resistant at the early stage of germination, and (3) the degree of injury advanced with the multiplication of the concentration as well as the prolongation of the treatment (vide Table 4). On the ground of these results, the method for observing many varieties was fixed as follows: Seeds were germinated for four days at 30°C, and the seedlings possessing coleoptiles of 0.5-1cm in length were selected. They were divided into four parts of ten plants in each, then soaked respectively in 0.05%, 0.2%, 1%, or 4% solution of $KC10_3$ for twenty-four hours, and after washed with water, they were kept again in petri-dishes for seven days at 30°C. The degree of injury was observed on the third, fifth, and seventh days after the treatment, and graded as the following four classes: (0) no visible injury, (1) partially or slightly contaminated and the growth being delayed, (2) contaminated wholly and the growth being inhibited, aud (3) killed and rotted. The degree of injury of a lot was shown by the average of index-numbers of the ten seedlings tested. Further, assuming the degree of injury to be proportional to the logarithm of concentration within a certain limit, the resistance of a variety was represenetd by the logarithm of concentration of pottasium chlorate solution necessary for giving rise to a definite degree of injury, 1.5 in the index-number given above.

Table 5. Varietal variation of pottasium chlorate resistance.

Districts	Conc. of $KClO_3$ for 1.5 degree of injury in logarithm								Total num. of vars.
	—3.67	—3.33	—3.00	—2.67	—2.33	—2.00	—1.67	—1.33	
Indochina	3	17	10	3	1	1	—	1	36
India & Siam	2	9	5	6	4	3	2	—	31
Formosa (plain part)	7	30	3	2	—	1*	—	—	43
South China	4	12	6	2	—	6	2	3	35
West China	1	12	2	—	2	—	1	3	21
Central China	—	12	6	7	2	4	2	14	47
North China	—	1	—	—	1	—	—	5	7
Formosa (mountain part)	—	1	3	2	2	—	5	2	15
Hai-Nan Island	—	1	—	—	1	1	13	5	21
Philippine	—	7	5	6	7	2	10	6	43
Celebes	—	3	6	4	3	5	10	3	34
Sunda Islands	—	6	2	—	—	1	13	15	37
Japan (lowland vars)	—	—	—	—	—	1	4	17	22
Japan (upland vars.)	—	—	—	—	—	—	8	6	14
Vars. of phenol reaction +	11	102	39	29	18	20	12	8	239
Vars. of phenol reaction —	1	6	7	4	4	7	56	70	155
Totals	12	108	46	33	22	27	68	78	394

* Horai varieties

Variation of pottasium chlorate resistance among the varieties of various districts is given in Table 5. It will be seen in Table 5 that the varieties are to be divided into two groups, resistant and non-resistant, as intermediate varieties being relatively few. Thus, varietal variation of this character seemed to be of discontinuous nature. The varieties positive in phenol reaction were mostly resistant to pottasium chlorate, and vise versa. Accordingly, geographical variation of this character was similar in the tendency to that of phenol reaction; resistant varieties were predominant in the continent of Eastern Asia, while non-resistant ones were in the island of western Pacific.

Table 6. Segregation of the degree of injury caused by $KClO_3$ (0.2%) among F_3 strains.

Crosses	Degree of injury					Total num. of strains
	0	0.5	1.0	1.5	2.0	
108 × 504	44	287	302	142	21	796
108 × 564	36	79	64	16	2	197

The degree of injury in parental varieties:

108 (Feh-ku)··2.5 504 (Taichung 65)··1.2 564 (Nakamura)··0.2

Though it may be difficult to work out the genetical behavior of pottasium chlorate

resistance, this character seems to be influenced by a number of genetical factors, as in F_2 hybrids between resistant and non-resistant varieties, most plants have been intermediate or relatively resistant. Table 6 gives examples of such a segregation.

(4) Low temperature resistance

Varietal variation of low temperature resistance has been dealt with by some workers in connection with drought resistance (1, 23, 40). Besides, it is well known in Formosa that Horai or Japanese varieties are more resistant than the native ones. In the present study, low temperature resistance of the varieties of various districts were observed by means of the treatment of seedlings in a refrigerator. It was found as a result of some preliminary experiment that (1) the injury of low temperature such as the delay of growth and contamination appeared after the treament gradually with the lapse of time, (2 the treatment beginning on the third or later days after the water soaking of seed (at 30°C) showed varietal difference in the degree of injury, and (3) the length of time of treatment little affected the degree of injury (vide Table 7).

Table 7. Relation of the number of days from water soaking of seeds to low temperature treatment (1) and the length of treatment (2) to the degree of injury.

Days from soak (1) \ Length (2) of treat.	1 day				2 days				4 days				6 days			
	28	101	563	638	28	101	563	638	28	101	563	638	28	101	563	638
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0.5	0.5	0	0	1.0	1.0	0	0
3	0.3	0.5	0	0	0.5	1.0	0	0	1.0	1.0	0	0	1.0	1.0	0	0
4	0	1.0	0	0	1.0	1.0	0	0	1.0	1.0	0.5	0.5	1.0	1.0	0.5	0.5
5	0	0	0	0	0.5	1.0	0.5	0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

The degree of injury:
0··no visible injury
0.5··growth being delayed and contaminated
1.0··killed and rotted

Varieties:
28··241 l n chim (Indochina)
101··u-kuh-tsing-you (Formosa)
563··Kinoshita-mochi (Japan)
638··poenoet hitam (Sunda Islands)

Thus, for the observation of each variety, seeds were germinated at 30°C for three or four days, and twenty seedlings possessing coleoptiles of about 1 cm in length were put in a petri-dish, and were kept in a low temperature thermostat regulated at ca. 1°C (never freeze) for one, three or five days. To avoid ununiformity of temperature, petri-dishes were rearranged at least once a day. The degree of injury was observed on the third aud fifth days after the treatment, and was graded as the three classes, (0) no visible injury, (0.5) the growth being delayed and contaminated, and (1) killed and rotted. The degree of injury of a lot was shown by the average of index-numbers of the twenty seedlings. As the treatment of one, three and five days all showed similar results, the low temperature resistance of a variety was represented by the average of the results of these three kinds of treatments.

Variation of low temperature resistance among the varieties of various districts is

given in Table 8. The varieties seemed to be divided into two groups, resistant and non-resistant, as intermediate varieties being relatively few. The varieties negative in phenol reaction tended to be more resistant than the positive varietiés. Then, the geographical variation of this character was similar in the tendency to the cases of phenol reaction and pottasium chlorate resistance; resistant varieties were predominant in Eastern Asiatic continent, while non-resistant ones were in the islands of western Pacific. Though the varieties of higher latitudal regions seemed in general to be slightly more resistant against low temperature than those of lower latitudal regions, it would be an interesting fact that highly resistant varieties were not few in tropical regions.

Table 8. Varietal variation of low temperature resistance (the degree of injury* by low temperature treatment).

Districts	Degree of injury					Total num. of vars.
	0	0.2	0.4	0.6	0.8	
Indochina	—	1	2	6	5	14
India & Siam	—	2	2	6	8	18
Formosa (plain part)	—	2*	—	9	5	16
South China	1	3	3	1	5	13
West & Central China	3	—	4	4	1	12
North China	4	—	1	—	1	6
Formosa (mountain part)	6	—	—	2	—	8
Hai-Nan Island	1	3	—	1	—	5
Philippine	2	5	1	4	4	16
Celebes	3	3	4	3	—	13
Sunda Islands	3	4	2	1	1	11
Japan (lowland vars.)	8	2	1	—	—	11
Japan(upland vars.)	2	4	1	1	—	8
Vars. of phenol reaction +	3	9	12	30	25	79
Vars. of phenol reaction —	29	21	9	8	5	72
Toals	32	30	21	38	30	151

* Horai varieties

In Formosa, growing the seedlings of various varieties in winter as the first crop, the death of definite varieties by cold injury will be experience frequently. The frequency of death in winter, observed otherwise, was found to agree well with the degree of injury by the low temperature treatment.

Considering from the appearance of varietal variation, low temperature resistance seems to be influenced by several genetical factors, though the inheritance has not been studied yet.

(5) Drought resistance

Drought resistance may imply in plant physiology the ability of a individual plant

or a cell to survive under the condition of water absorbtion being impossile (44). On the other hand, drought resistance may be often expressed in agronomy in terms of the growth or yield under insufficient water supply, and thus the stage of growth, the depth of root system and other ecological characters, in addition to physiological drought resistance, may take part in it. It may be due to the confusion of different senses of the same word that the essential nature of drought resistance in the rice plant has not yet been understood thoroughly in spite of numerous studies on it.

Drought resistance in the present study was examined by so-called Mimosa method (37). It means thus the ability of a plant to survive without available water in soil and to recover after watering. Twenty seedlings of rice and one plant of Mimosa pudica were planted in a pot of 25 cm in diameter, and grown with proper care. When the rice plants stretched from 'five to seven leaves and the root of Mimosa developped fully, watering was stopped. Then, observing the stimulated movement of Mimosa everyday, the time of suspension of movement by drying was determined, and after five or six days the pot was watered fully. The number of days of treatment, five or six days, was determined by a preliminary test. The percentage of survival and the degree of drought injury were observed two days and four days after the watering. The degree of injury was graded as the five classes, (0) without visible injury, (1) one or two lower leaves being dead, (2) a half of leaves being dead, (3) only one or two upper leaves surviving, and (4) dead wholly. The index-numbers of the twenty plants were averaged on each variety. The varieties of various districts were tested three times in different seasons.

Table 9. Varietal variation of drought resistance (measured by Mimosa method).

Districts	Degree of injury							% of survival					Total num. of vars.
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	20	40	60	80	100	
Indochina	—	1	6	2	—	—	—	—	—	—	1	8	9
India & Siam	—	5	4	3	—	2	—	—	—	3	4	7	14
Formosa (plain part)	2	7	2	1	—	1*	—	—	1*	—	2	10	13
South China	—	5	5	1	1	1	—	—	—	2	3	8	13
Central China	2	2	3	2	1	—	—	—	—	1	2	7	10
North China	—	1	1	—	1	2	—	—	2	—	1	2	5
Formosa (mountain part)	—	1	2	2	—	1	—	—	—	1	3	2	6
Hai-Nan Islands	—	1	—	1	2	1	—	—	—	3	1	1	5
Philippine	—	2	—	1	5	4	1	2	1	7	1	2	13
Celebes	—	2	—	2	3	1	—	—	1	3	2	2	8
Sunda Islands	—	—	2	2	2	5	—	—	5	4	1	1	11
Japan (lowland vars.)	—	—	—	1	1	5	—	—	2	4	1	—	7
Japan (upland vars.)	—	—	—	—	1	2	1	2	1	1	—	—	4
Vars. of Phenol reaction +	3	25	20	9	2	3	1	2	—	5	14	42	63
Vars. of Phenol reaction —	1	2	5	9	15	22	1	2	13	24	8	8	55
Totals	4	27	25	18	17	25	2	4	13	29	22	50	118

Explanation of the degree of injury is in text.
* Horai varieties.

Variations of the degree of injury and the percentage of survival among the varieties are given in Table 9. The varietal variation seemed to be discontinuous to some extent, as intermediate varieties being relatively few. Among the varieties positive in phenol reaction, those resistant to drought were relatively large in number, and vice versa. Then, the geographical variation showed similar tendency to the cases of phenol reaction and other above mentioned characters; resistant varieties were predominant in Eastern Asiatic continent, while non-resistant ones were in the islands of western Pacific. These tendencies were found similarly in the degree of drought injury as well as in the percentage of survival, and these two characters were found to be correlated intimately inter se (r=0.87). Therefore, these two characters seem to be different expressions of an essentially same property.

According to the appearance of varietal variation, drought resistance seems to be influenced by a number of genetical factors, though the inheritance being unknown.

(6) The number of days of germination

It is well known that the speed of germination differs with the temperature and other conditions as well as the age of seed, and these matters being constant, varietal difference shows itself clearly (5, 17, 26, 32, 35). In the present study, germination tests were carried out on a greater part of the preserved varieties. Fully after-ripened seeds which had been kept in desiccators for three to six monthes after harvest and

Table 10. Varietal variation of the days of 50% germination at 30°C.

Districts	Num. of days					Total num. of vars.
	1.5	2.0	2.5	3.0	3.5	
Indochina	19	2	1	—	—	22
India & Siam	15	6	6	—	1	28
Formosa (plain part)	38	1	1*	—	—	40
South China	23	8	4	2	—	37
West China	17	3	2	—	—	22
Central China	21	6	14	4	2	47
North China	1	—	5	1	—	7
Formosa (mountain part)	7	1	4	1	2	15
Hai-Nan Island	1	2	15	2	—	20
Philippine	7	5	10	2	—	24
Celeces	5	3	8	2	—	18
Sunda Isladns	1	5	23	2	—	31
Japan (lowland vars.)	3	4	15	—	—	22
Japan (upland vars.)	5	6	2	1	—	14
Vars. of phenol	153	28	21	1	—	203
reaction	20	24	90	16	5	155
Totals	173	52	111	17	5	358

* Horai varieties

more than 95% in germinating capacity were used. One lot of fifty sterilized seeds was bedded on a moistened blotting paper layed in a petri-dish, and was put in an incubator regulated at 30°C. Observing the germination everyday, the number of days necessary for the germination of 50% of seeds was calculated. Such germination tests were repeated twice in different years on each variety.

Variation of the days of fifty percents germination among the varieties of various districts is given in Table 10. The varietal variation seemed somewhat to be of discontinuous nature, and two varietal groups, fast and slow in germination seemed to be distinguishable. Varieties positive in phenol reaction were mostly faster in germination than negative ones. In geographical variation, a tendency similar to the cases of phenol reaction and other characters was pointed out.

These phenomena were recognizable more evidently when the temperature was lower than 30°C. Those results will be reported in another paper. According to the appearance of varietal variation, a number of genetical factors seems to be concerned in the varietal difference of germinating speed.

(7) The number of days of maturation of endosperm

The number of days from the opening of flower to the maturation of seeds differs with variety. It is well known in Formosa that the native varieties are faster in the maturation of seed than Horai or Japanese varieties. In the present study, the number of days from the heading to the hardening of endosperm was investigated on the varieties of various districts. Taking ten ears per variety, the dates of heading and

Table 11. Varietal variation of the speed of maturation of endosperm (number of days from heading to the hardening of endosperm).

Districts	Num. of days								Total num. of vars.
	10	11	12	13	14	15	16	17	
Indochina	—	5	3	—	—	—	—	—	8
India & Siam	1	8	2	1	1	—	—	—	13
Formosa (plain part)	1	8	2	—	—	1*	—	—	12
Chinese Continent	2	10	7	3	1	2	—	2	27
Formosa (mountain part)	—	—	4	2	—	—	—	—	6
Hai-Nan Island	—	1	—	—	1	3	—	—	5
Philippine	—	—	1	8	2	—	—	—	11
Celebos	—	1	2	3	2	—	—	—	8
Sunda Islands	—	—	2	7	2	—	—	—	11
Japan	—	—	1	4	2	2	2	—	11
Vars. of phenol +	4	29	18	5	1	1	—	—	58
reaction —	—	4	6	23	10	7	2	2	54
Totals	4	33	24	28	11	8	2	2	112

* Horai varieties

the hardening of grains in the upper part of ear were observed, and the days from heading to hardening of those ten ears were averaged. The number of days of maturation was found to be smaller at higher temperature and under fine weather, whereas during the period of observing a larger part of the varieties, that was from early May to early June, 1948, it was fine almost everyday and the temperature of daily average was approximately between 25° and 27°C.

Variation of the speed of endosperm maturation among the varieties of various districts is given in Table 11. Though the variation seemed nearly continuous, the varieties positive in phenol reaction were mostly faster in endosperm maturation than the negative ones, and the geographical variation seemed to have a tendency similar to the cases of phenol reaction and other characters.

According to the appearance of varietal variation, a number of genetical factors seems to be concerned in this character in the same way as in the other characters mentioned above. This character was found to be correlated intimately with the days of germination (vide Table 21). These two characters may possibly be influenced by same genetical factors.

(8) Shedding of grain

Shedding is due to the development of separating layer at the basal part of grain (41), and it seems to become easier with the lapse of days after the formation of grain as well as with the fall of temperature during maturation. In the present study, ears

Table 12. Varietal variation of the weight of grain shedding

Districts	Weight in gr.										Total num. of vars.
	25	50	75	100	125	150	175	200	225	250	
Indochina	—	3	5	6	1	—	—	—	—	—	15
India & Siam	1	3	7	3	1	—	—	—	—	—	15
Formosa (Plain part)	—	1	13	8	—	1*	—	—	—	—	23
South China	—	4	3	5	—	1	—	—	—	—	13
Central China	—	2	2	3	1	1	—	—	—	—	9
North China	—	—	4	—	—	—	—	1	—	—	5
Formosa (mountain part)	—	—	1	3	1	3	2	—	—	—	10
Hai-Nan Island	—	—	—	1	1	1	—	1	—	1	5
Philippine	—	8	10	3	3	2	1	—	1	—	28
Celebes	—	1	2	6	3	5	1	1	—	—	19
Sunda Islands	—	—	—	—	—	3	2	2	4	1	12
Japan (lowland vars.)	—	—	4	1	1	2	5	—	—	—	13
Japan (upland vars.)	—	—	1	4	6	2	—	—	—	—	13
Vars. of phenol reaction +	1	18	41	32	10	3	1	—	—	—	106
Vars. of phenol reaction —	—	4	11	11	8	18	10	5	5	2	74
Totals	1	22	52	43	18	21	11	5	5	2	180

* Horai varieties

of the varieties of various districts, matured in high temperature period, harvested at proper stages, and preserved indoors for less than one month, were used, and the weight of shedding of single grain was measured by using Yamasaki's shedding-meter on more than fifty grains per variety. Measurements were repeated three times in 1944, 1945, and 1949, and the results were averaged.

Varietal variation of the weight of shedding is given in Table 12. This character, varying on a wide range among the varieties, did not showed a clear discontinuity of variation. However, most of the varieties positive in phenol reaction were shed easily, and those negative in phenol reaction varied on a wider range. The geographical variation was similar in the tendency somewhat to the cases of phenol reaction and other characters; the varieties hard to be shed were found mostly in Japan, Formosa (Horai and the native varieties of mountain part), Philippine, Celebes and Sunda Islands.

According to Izumi (7), Onodera (28), Ramiah (30) and others, shedding is determined at least by several kinds of genetical factors.

(9) The length of awn

Presence or absence and the length of awn differ to a considerable extent with the outer conditions (4, 5). Varieties of various districts were grown in nine different seasons at the interval of one to two monthes (the details will be reported in another paper), and the length of awn in different seasons was measured. All grains of five ears per variety were measured at one time of growing, regarding awnless grains as zero. And it was found, as given in Table 13, that the awn became longer in the period of high temperature. Then, the length of awn of a variety was shown by the average of results in different seasons.

Table 13. An example of seasonal variation of the length of awn.
Variety: 617 (Padi ase banda, Celebes), insensible to day length.

No. of sowing	I	II	III	IIII	V	VI	VII	VIII	Average
Date of heading	17/10	16/4	15/5	8/6	24/7	14/8	16/9	15/10	
Length of awn in mm.	33.0 *± 6.24	19.4 ± 10.2	38.0 ± 12.6	39.3 ± 14.0	39.3 ± 13.6	44.7 ± 13.5	41.8 ± 12.8	39.3 ± 10.0	35.6

* standard deviation of a single determination

Varietal variation of the length of awn is given in Table 14. As most of the varieties being either awnless or more than 20 mm in length and intermediate varieties being rare, two varietal groups, awnless and awned, were distinguishable clearly. Awned varieties were mostly negative in phenol reaction, and awnless varieties were either positive or negative in phenol reaction. The geographical variation was similar in the tendency to the cases of phenol reaction and other characters.

With regard to the inheritance of awnedness, a number of works (8, 15, 25, 33) has demonstrated that the length of awn is controlled by the interaction of several multiple

factors and in some cases by inhibitory factors in addition. The authors also arrived at a similar conclusion; those data will be reported at another opportunity.

Tabe 14. Varietal variation of the length of awn.

Districts	Length in mm. (mid-points of log. class interval) 1.3	2.0	3.2	5.0	8.0	12.6	20.0	31.5	50.0		Total num. of vars.
Indochina	8	1	—	—	—	—	—	—	—	—	9
India & Siam	13	—	—	—	—	1	—	1	—	—	15
Formosa (plain part)	13	—	—	—	—	—	—	—	—	—	13
South China	11	—	—	—	1	—	—	—	1	—	13
Central China	7	1	—	—	—	—	—	1	—	—	9
North China	3	—	—	—	—	—	—	—	2	—	5
Formosa (mountain part)	5	—	—	—	—	—	—	—	1	—	6
Hai-Nan Island	4	—	—	—	—	—	—	—	1	—	5
Philippine	12	—	—	1	—	—	—	—	—	—	13
Celebes	3	—	—	—	—	—	—	—	5	—	8
Sunda Islands	2	—	—	—	—	1	—	1	6	1	11
Japan (lowland vars.)	4	—	—	1	—	—	1	—	1	—	7
Japan (upland vars.)	—	—	—	2	—	—	—	2	—	—	4
Vars. of phenol reaction +	55	1	—	2	—	1	—	2	1	—	62
Vars. of phenol reaction −	30	1	—	2	1	1	1	3	16	1	56
Totals	85	2	—	4	1	2	1	5	17	1	118

(10) The length of glume hair

Numerous hairs of singular cell grow on the surface of inner and outer glumes, and are longer and denser at the apical part of glumes. The length of hairs at the apical part were measured on various varieties by using a low power microscope. More than fifty hairs of three grains per variety were measured.

Table 15. Varietal variation of the length of glume hair.

Districts	Length in micra										Total num. of vars.
	0	100	200	300	400	500	600	700	800	900	1mm or more	
Indochina	—	—	5	5	3	—	—	—	—	—	—	13
India & Siam	—	—	9	5	—	1	2	—	—	—	—	17
Formosa (plain part)	—	—	2	10	2*	—	—	—	1	—	—	15
South China	—	—	5	2	—	1	—	1	—	—	—	9
Central China	—	—	5	—	—	1	1	—	—	—	—	7
North China	—	—	—	1	—	—	—	2	2	—	—	5
Formosa (mountain part)	—	—	1	1	1	1	1	1	—	—	1	7
Hai-Nan Islands	1	—	—	1	—	1	2	—	—	—	—	5
Philippine	5	—	1	3	3	1	1	—	—	—	—	14
Celebes	—	—	2	4	1	3	1	—	—	—	—	11
Sunda Islands	—	—	—	—	1	1	5	—	1	1	1	10
Japan (lowland vars.)	—	—	—	—	2	3	1	1	—	—	—	7
Japan (upland vars.)	—	—	—	3	1	—	—	—	—	—	—	4
Vars. of phenol reaction +	—	—	24	31	5	2	2	—	1	—	—	65
Vars. of phenol reaction −	6	—	6	4	9	11	12	5	3	1	2	59
Totals	6	—	30	35	14	13	14	5	4	1	2	124

* Horai varieties

Varietal variation of the length of hair is given in Table 15. It was seemingly continuous, whereas the varieties positive in phenol reaction tended to be shorter in the length, and the varieties negative in phenol reaction showed a wider range of variation. The tendency of geographical variation were somewhat similar to the cases of phenol reaction and other characters.

A variety of Sunda Islands (344 : Betong) was found to be as long as exceeding 1.8mm. On the other hand, a few varieties of Philippine and Hai-Nan Island were hairless. This hairless was found to be expressed by two recessive genes, while the length of hair in ordinary haired varieties seemed to be influenced by a number of multiple factors. Examples of the segregation are given in Table 16. An intimate intervarietal correlation was pointed out between the length of hair and the length of awn in awned varieties (r=0.79). These two characters may be supposed to be influenced by same genetical factors.

Table 16. Some examples of segregation of the length of glume hair in F2s.

Crosses (Length in parents)	Length of hair in micra							Total
	200	300	400	500	600	700	800	num.
108 x 703 (262) (685)	1	15	54	37	12	2	1	122

	Obs: Num.		Exp. Num. (15 : 1)		X^2
	Haired	Hairless	Haired	Hairless	
219 x 108 (0) (262)	103	4	100.3	6.7	1.16
219 x 421 (0) (247)	74	4	73.1	4.9	0.21
647 x 219 (475) (0)	162	13	164.1	10.9	0.43

(11) Length-width ratio of unhulled rice

Length-width ratio of hulled rice has been observed by a number of workers (2,10, etc.) as a character availabe for the practical classification of varieties, and its geographical variation was investigated by Negamatsu (24). As the shape of hulled rice being dependent upon the shape of hull, the shape of unhulled rice, observed in the present study, will be a character same to the shape of hulled rice. Almost all preserved varieties were observed on the length and the width of unhulled grain. Ten fully enriched grains per variety were measured by using a calipers.

Varietal variation of the ratio is given in Table 17. The ratio ranged, roughly speaking, from two to four among varieties, while a greater part of the varieties was between 2.4 and 3.0. The varietal variation seemed to be continuous. Unlike the cases of other characters mentioned above, varieties positive in phenol reaction and negative ones were similar in the mode of varietal variation. Accordingly, the geographical variation of this character was also different from the cases of phenol reaction and other

Table 17. Varietal variation of the length-width ratio of unhulled rice.

Districts	Length-width ratio													Total num. vars.
	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	
Indochina	—	—	1	1	3	13	25	16	8	4	—	4	1	76
India & Siam	—	—	5	8	21	11	11	2	3	4	1	2	1	69
Philippine	—	—	1	6	14	14	15	13	3	1	3	3	1	74
Celebes	—	4	2	3	17	21	11	6	3	3	4	—	—	74
Sunda Islands	1	4	4	9	9	16	11	7	2	3	2	—	—	68
Hai-Nan Island	—	2	1	7	9	7	1	2	1	1	—	—	—	31
South China	—	—	4	4	13	11	5	5	—	1	—	—	1	44
Central China	—	5	10	5	11	12	5	—	—	—	—	—	—	48
West China	—	—	2	2	3	11	6	—	—	—	—	—	—	24
North Cnina	—	—	3	—	1	3	2	—	—	—	—	—	—	9
Formosa (plain part)	1	4*	4*	23	21	7	2	—	—	—	—	—	—	62
Formosa (mountain part)	—	3	19	14	17	6	1	1	—	—	—	—	—	61
Japan (lowland vars.)	1	12	7	4	1	—	—	—	—	—	—	—	—	25
Japan (upland vars.)	—	2	8	7	4	—	—	—	—	—	—	—	—	21
Vars. of phenol reaetion +	3	22	31	55	101	92	73	35	14	12	7	8	2	455
Vars. of phenol reaetion —	—	14	40	38	43	40	22	17	6	5	3	1	2	231
Totals	3	36	71	93	144	132	95	52	20	17	10	9	4	686

* Horai varieties

characters; the varieties of higher latitudal regions were small uniformly in the ratio, while those of lower latitudal regions varied on a wider range. These respects agree well with Mr. Nagamatsu's result.

Table 18. Varietal variation of the width of unhulled rice.

Phenol reaction	2.1 mm	2.4	2.7	3.0	3.3	3.6	3.9	Total num. of vars.
+	—	33	105	178	86	26	4	432
—	2	13	27	67	83	59	15	266
Totals	2	46	132	245	169	85	19	698

Varietal variation of the length of unhulled rice was similar to that of the length-width ratio. With regard to the width of unhulled rice, the varieties positive in phenol reaction were found generally to be smaller than the negative ones (vide Table 18).

It has been pointed out by a number of works (19, 20, etc.) that several multiple factors exert influence on the size and shape of rice grain.

(12) The length of first and second internodes

Hamada (3) pointed out that the length of first internode, viz. so-called mesocotyl,

grown without light, was longer in Indica type than in Japonica type. Okura and Miyata (27) and Mizushima (22) showed, however, that varietal variation of the length of mesocotyl was of continuous nature and did hardly prove the distinction of the two types. Dr. T. Shibuya and one of the present authors (34), dealing also with the variation of this character, came to such a conclusion: The length of organs of rice seedling varys with the temperature and the moisture content of culture media, and while the varietal variations as a whole are continuous, the varieties of higher latitudal regions tend to be relatively short in the length of first and second internodes, and those of lower latitudal regions vary on a wider range.

As the materials used in this work being same to those of the present study, then adding the data obtained later, varietal variations of the length of first and second internodes were investigated again. The results were, as given in Tables 19 and 20, similar to those mentioned above; The varieties positive in phenol reaction and those negative were not different in the range of varietal variation. The length of first internode and that of second internode did not showed a signifcant intervarietal correlation inter se (r=0.133).

Table 19. Varietal variation of the length of first internode.

Districts	Length in mm. (Mid-points of logarithmic class interval)												Total num. of vars.
	1.26	2.0	3.16	5.0	8.0	12.6	20.0	31.6	50.0	80.0	126		
Indochina	1	—	4	10	18	7	12	7	1	1	1	1	62
India & Siam	2	2	1	2	3	—	1	6	10	4	5	8	44
Formosa (plain part)	—	—	3	6	5	2	10*	6	8	9	1	4	54
South china	1	—	3	1	2	—	—	1	5	3	2	—	18
Central China	2	1	1	—	2	—	1	2	1	—	—	—	10
North China	2	—	—	1	—	1	1	1	—	—	—	—	6
Formosa (mountain part)	—	—	—	—	1	—	2	2	1	3	4	—	13
Hai-Nan Island	—	—	—	—	—	1	4	5	3	5	2	—	20
Philippine	—	—	—	—	—	3	5	8	22	14	18	2	72
Celebes	—	—	—	—	1	6	5	8	10	5	1	—	36
Sunda Island	1	—	1	—	1	1	5	10	11	8	4	—	42
Japan lowland vars.)	—	—	—	3	5	12	7	4	2	—	—	—	33
Japan (upland vars.)	—	—	—	1	1	3	5	6	5	1	—	—	22
Vars. of phenol reaction +	6	2	10	20	25	18	36	37	47	31	32	15	279
Vars. of phenol reaction −	3	1	3	4	14	17	22	29	32	22	6	—	153
Totals	9	3	13	24	39	35	58	66	79	53	38	15	432

* Horai varieties

The extent of elongation of these organs may presumably depend upon the quantity and distribution of growth hormones produced in the inner part of plant and may be controlled by numerous genetical factors.

Table 20. Varietal variation of the length of second internode.

Districts	Length in mm (mid-points of log. class intereals)										Total num. of vars.
	1.26	2.0	3.16	5.0	8.0	12.6	20.0	31.6	50.0		
Indochina	—	2	—	1	1	15	25	17	—	1	62
India & Siam	3	—	1	1	3	5	11	14	4	—	42
Formosa (plain part)	3*	—	—	1	1	1	16	26	5	—	53
South China	4	—	—	—	1	—	2	7	4	—	18
Central China	6	—	—	—	—	1	—	1	2	—	10
North China	4	—	—	1	—	—	—	1	—	—	6
Formosa (mountain part)	—	—	—	—	1	3	4	4	1	—	13
Hai-Nan Island	1	—	—	—	2	2	7	8	—	—	20
Philippine	10	3	2	9	11	13	9	11	2	—	70
Celebes	—	—	—	—	2	3	7	6	13	5	36
Sunda Islands	1	—	1	—	3	3	15	14	5	—	42
Japan (lowlard vars.)	27	1	1	2	1	—	—	—	—	—	32
Japan (upland vars,)	17	1	—	—	2	2	—	—	—	—	22
Vars. of phenol reaction +	25	5	3	7	16	33	62	86	33	5	275
Vars. of phenol reaction —	51	2	2	8	12	15	34	23	3	1	151
Totals	76	7	5	15	28	48	96	109	36	6	426

*Horai varieties

(13) Intervarietal correlations among the above mentioned characters.

Table 21. Intervarietal correlations among various characters (correlation coefficients).

	(2) Destruction of endosperm by KOH	(3) $KClO_3$ resist.	(4) Low temp. resist.	(5) Drought resist.	(6) Days of germi.	(7) Days of maturation	(8) Weight of shedding	(9) Length of awn	(10) Length of hair	(11) Length-width ratio of rice
(3) $KClO_3$ resist.	0.541 **									
(4) Low temp. resist.	0.579 **	0.592 **								
(5) Drought resist.	−0.521 **	−0.748 **	−0.544 **							
(6) Days of germi.	0.295 **	0.757 **	0.648 **	−0.655 **						
(7) Days of maturation	0.562 **	0.735 **	0.668 **	−0.653 **	0.556 **					
(8) Weight of shedding	0.398 **	0.599 **	0.541 **	−0.498 **	0.477 **	0.466 **				
(9) Length of awn	0.449 **	0.517 **	0.420 **	−0.474 **	0.406 **	0.358 **	0.515 **			
(10) Length of hair	0.508 **	0.677 **	0.642 **	−0.515 **	0.678 **	0.624 **	0.506 **	0.787(1) **		
(11) Length-width ratio of rice	−0.319 **	−0.284 **	−0.348 **	0.154	−0.223 *	−0.306 **	−0.115	−0.196 *	−0.194 *	
(12) Length of 1st internode	−0.262 **	−0.050	−0.176	0.047	−0.042	−0.262 **	0.077	−0.067	−0.136	0.206 *

** beyond 1% level, * between 1% and 5% levels.

(1) regarding to awned varieties only.

The propensity of correlation among the varietal variations of various characters mentioned above was in terms of correlation coefficient as given in Table 21. It may be seen in Table 21 that correlations are conspicuous among such characters as showing difference of a definite tendency between the varieties positive in phenol reaction and the negative ones, and also showing geographical variation similar in the tendency to that of phenol reaction. Particularly, the characters which showed discontinuity of variation, such as pottasium chlorate resistance, low temperature resistance, drought resistance and others, were correlated intimately inter se. These correlations will be, as being presumable from the fact that the varieties positive in phenol reaction and the negative ones have been contrary to each other in various characters, due to the preponderance of varieties possessing definite kinds of charcter combination. Therefore, the

Table 22. Examples of abnormal distribution of frequency in correlation tables.

(a) Correation between the length of awn and pottasium chlorate resistance.

Length of awn in mm (mid-points of logarithmic class intervals)	Conc. of $KClO_3$ in log. (vide Table 5)								Total
	− 3.67	− 3.33	− 3.00	− 2.67	− 2.66	− 2.00	− 1.67	− 1.33	
1.3	3	29	14	5	3	3	16	10	83
2.0	—	1	1	—	—	—	—	1	3
3.2	—	—	—	—	—	—	2	2	4
5.0	—	—	1	—	—	—	—	—	1
8.0	—	—	—	1	—	—	—	1	2
12.6	—	—	—	—	—	—	—	1	1
20.0	—	—	—	—	—	—	1	3	4
31.6	—	—	—	—	—	—	8	8	16
50.0	—	—	—	—	—	—	1	—	1
Total	3	30	16	6	3	3	28	26	115

(b) Correlation between the weight of grain shedding and pottasium chlorate resistance.

Weight of shedding in gr	Conc. of $KClO_3$ in log.								Total
	− 3.67	− 3.33	− 3.00	− 2.67	− 2.33	− 2.00	− 1.67	− 1.33	
25	—	1	—	—	—	—	—	—	1
50	1	8	5	2	1	1	1	—	19
75	4	12	12	4	4	2	5	6	49
100	—	20	2	5	3	2	5	5	42
125	—	3	1	—	—	—	8	6	18
150	—	—	1	—	—	1	12	7	21
175	—	—	—	—	—	—	6	5	11
200	—	—	—	—	—	—	2	3	5
225	—	—	—	—	—	—	1	4	5
250	—	—	—	—	—	—	1	—	1
Total	5	44	21	11	8	6	41	36	172

correlation coefficients will serve as a measure of preponderancy of definite character combinations.

It should be admitted, however, that the frequency distribution in the correlation tables were not always normal. Especially, concerning several characters showing complete discontinuity of varietal variation, peculiar shapes of frequency distribution, as given in Table 22, were found. In such cases, correlation coefficients may not evaluate the propensity of correlation correctly. Nevertheless, it may be recognizable in these correlation tables that definite character combinations are preponderant and thus the used varieties are to be divided into two groups.

(14) Frequency of varieties possessing various kinds of character combinations.

Varietal variations have been found to be discontinuous in the following five characters: phenol reaction, pottasium chlorate resistance, low emperature resistance, drought resistance, and the length of awn. Therefore, in regard to each of these characters, the used varieties may be divided into two groups and the characteristics of a given variety may be represented by a simple word, positive or negative, or, plus or minus. Thus, with regard to these five characters, denoting each character by one sign, plus or minus, a variety may be symbolized by a combination of five signs. Posssible combinations of five signs will be $2^5=32$ in total number. If these 32 kinds of character combinations all were similar in frequency, the given population of varieties should be considered to be composed of random combinations of genic changes, and there would be no evidence of phylogenetical differentiation to be expected in it. However, it will be presumed without difficulty from the above mentioned facts that definite kinds of character combinations will preponderate among the used varieties.

Having investigated the frequency of varieties possessing each of these 32 kinds of character combinations, the results given in Table 23 was obtained. It will be seen in Table 23 that such varieties are large in number as either belonging to combination no. 24, viz phenol reaction being plus (positive), pottasium chlorate resistance and low temperature resistance being minus (weak), drought resistance being plus (resistant), and the length of awn being minus (awnless), or belonging to combination no. 9 and no. 22 which are contrary to the above in every respects or except the length of awn. Thus, a majority of the used varieties can be divided into two variety-groups represented respectively by these two types of character combination. For the discrimination of these two variety-groups, use of pottasium chlorate resistance will be good, since it shows the most clear discontinuity of varietal variation.

Besides these two variety-groups, however, few varieties possessing other various kinds of character combinations will be found further in Table 23. Since particular care has been taken that diverse character combinations would not be resulted from the inaccuracy of observation, the existence of varieties as showing these extra character combinations seems to be without doubt. Then, we may come to such a conclusion that the varieties of rice plant are as a tenedency to be divided into two variety-groups, reserving some varieties which belong to neither of the two.

Table 23. Character combinations found among the used varieties and the frequency of varieties as showing each of those combinations.

Characters	no. of character combination															Total num. of vars.
	24	13	11	28	32	7	30	20	10	15	6	5	16	9	22	
Phenol reaction	+	+	+	−	−	−	−	−	−	+	+	+	+	−	−	
$KClO_3$ resist.	−	−	−	−	−	−	+	+	+	+	+	+	+	+	+	
Low temp. resist.	−	+	−	−	−	+	−	−	+	−	+	+	+	+	+	
Drought resist.	+	+	+	+	−	+	−	−	+	+	+	−	−	−	−	
Length of awn	−	−	+	−	−	+	−	+	−	−	−	+	−	+	−	
Indochina	10	2	−	1	−	−	−	−	−	−	−	−	−	−	−	13
India & Siam	9	1	1	1	−	−	1	−	−	2	−	−	−	−	1	15
Formosa (plain part)	15	−	−	−	−	−	−	−	−	−	−	−	−	−	1	16
South China	7	2	−	1	−	1	−	−	−	−	−	−	−	1	1	13
Central China	3	3	−	2	−	−	−	−	1	−	−	−	−	1	2	12
North China	1	1	−	−	−	−	−	−	−	−	−	−	−	2	2	6
Formosa(mountain part)	2	−	−	−	−	−	−	−	1	−	1	−	1	3	−	8
Hai-Nan Island	1	−	−	−	−	−	−	−	−	−	−	−	1	1	2	5
Philippine	3	−	−	−	1	−	1	−	−	−	−	−	−	1	8	14
Celebes	4	−	−	−	−	−	−	−	−	−	−	−	−	8	1	13
Sunda Islands	−	−	−	−	−	−	−	2	−	−	−	1	−	7	2	12
Japan (lowland vars.)	−	−	−	−	−	−	−	−	−	−	−	−	−	4	7	11
Japau (upland vars.)	−	−	−	−	−	−	−	−	−	−	−	4	2	2	−	8
Totals	55	9	1	5	1	1	2	2	2	2	1	5	4	30	27	147
Variety-groups	Continental				(Indistinct)							Insular				

Fifteen kinds of character combinations were found actually.

It will be recognizable, further, looking over the geographical distribution of various character combinations given in Table 23, that combination no. 24 distributes mainly over the continent of Eastern Asia, viz. China, Indochina, and India, while combinations no. 9 and no. 22 distribute mainly over the islands of Western Pacific, viz. Japan, Formosa (Horai and the native varieties of mountain part), Philippine, Celebes and Sunda Islands, in addition to Northern China. It may be said, with proper qualifications, that these two different types of character combinations are corresponding to so-called Indica and Japonica types respectively, but it will be better for the sake of expressing the tendency of geographical distribution to name these variety-groups as "Continental" and "Insular" groups.

(15) Differention within Continental and Insular variety-groups.

The used varieties were divided into Continental and Insular variety-groups conveniently according to the resistance against pottasium chlorate. And intervarieral correlarions within each variety-group were investigated. The correlations are given

Table 24. Intervarietal correlations within "Continental" and "Insular" variety-groups.

Insular \ Continental	(2) Destruc. of endo-sperm	(4) Low temp. resist.	(5) Drought resist.	(6) Days of germi.	(7) Days of matu-ration	(8) Weight of shed-diug	(9) Length of awn	(10) Length of hair	(11) Length width ratio of rice	(12) Length of 1st inter-node
(2) Destruction of endo-sperm by KOH		0.116	−0.119	0.178	0.096	0.128	0.102	0.250 *	0.237 *	−0.068
(4) Low temp. resistance	0.426 **		0.032	0.034	0.029	0.030	0.111	0.003	−0.177	−0.175
(5) Drought resistance	−0.036	−0.069		−0.218	−0.081	0.189	−0.110	0.061	−0.312 *	−0.077
(6) Days of germination	0.299	0.441 **	−0.224		0.117	−0.343 **	0.069	0.161	0.094	0.231
(7) Days of maturation	0.310 **	0.401 **	−0.259 *	0.268 *		0.302 *	—	0.286 *	0.019	0.105
(8) Weight of shedding	−0.162	0.057	−0.053	−0.042	−0.053		—	−0.045	−0.121	−0.001
(9) Length of awn	0,226	0.082	−0.152	0.335 **	—	—		—	—	—
(10) Length of hair	0.187	0.386 **	−0.138	0.299 *	0.137	0.120	—		−0.116	0.136
(11) Length-width ratio of rice	−0,500 **	−0.265 *	0.255 *	−0.131	−0.346 *	0.282 *	—	0.064		−0.064
(12) Length of 1st inte-rnode	−0.544 **	−0.245 *	0.144	−0.415 **	−0.529 **	0.259 *	—	−0.239	0.405 **	

** beyond 1% level, * between 1% and 5% levels.

in Table 24 in terms of correlation coefficient. Comparing Table 24 with Table 21 given above, there may be found frequently such a case that two characters which showed a marked correlation among the whole used varieties are no longer correlated within a same variety-group. It may be confirmed, accordingly, that the correlation of various characters among the whole varieties are due to the preponderance of the two types of character combinations as mentioned above.

According to Table 24, however, intervarietal correlations within Insular variety-group will be found among several characters, such as the degree of destruction of endosperm by caustic potash, the length-width ratio of unhulled rice, the length of first internode, and others. Insular group may be presumed, therefore, to possess a definite tendency of character combination within it. As these characters being continuous in intervarietal variacion, these correlations may point only the direction of intervarietal differentitation, and to classify the varieties by them seems to be difficult. However, for the purpose of expressing the situation clearly, each of the above mentioned three characters was represented by the sign, plus or minus, dividing the range of variation into two parts at the middle point, and thus the characteristics of a variety was symbolized by a combination of three signs. In this case, eight kinds of character combinations will be possible in total; the frequency of varieties showing each of these eight kinds was as given in Table 25.

It may be seen in Table 25 that combination no. 5, viz. endosperm being destructed heavily by caustic potash, the length-width ratio of unhulled rice being small, and the first internode being short, and combination no. 4, that is contrary in each character, are markedly large in number. Therefore, it may be a proper way to express the

Table 25. Character combinations in "Insular" variety-group. and the frequency of varieties as showing each character combination.

Characters	(4)	(7)	(6)	(2)	(1)	(3)	(5)	Total num. of vars.
(2) Destruction of endosperm by KOH	−	−	−	+	+	+	+	
(11) Length-width ratio of unhulled rice	+	−	+	+	+	−	−	
(12) Length of 1st internode	+	+	−	−	+	+	−	
Sunda Islands	8	2	1	—	1	—	—	12
Celebes	1	1	1	1	2	2	1	9
Philippnie	7	3	—	—	—	1	—	11
India	—	—	1	—	—	—	—	1
Hai-Nan Island	—	1	—	1	1	—	1	4
Formosa	—	—	—	—	1	2	4	7
China	1	—	—	—	1	1	6	9
Japan (lowland vars.)	—	—	—	—	—	1	11	12
Japan (upland vars.)	—	—	1	—	1	2	2	6
Totals	17	7	4	2	7	9	25	71
Variety-groups	Tropical						Temperate	

Seven Kinds of character combinations were found actually.

direction of differentiation to divide Insular variety-group into two minor groups. The varieties belonging to combination no. 5 may be named as "Temperate Insular", as they are distributing mostly over the temperate regions such as Japan and Northern China. In contrast to this, the varieties belonging to other character combinations, distributing over tropical regions, may be named as "Tropical Insular" group.

Discussion

It is necessary for the study of phylogenetical differentiation, as mentioned in some paragraph of the introduction, to produce an evidence to speculate the frequency of gene combinations being higher in definite kinds than in others, i. e. the preponderance of definite gene combinations.

The above given observation results may present in this connection the following facts: (1) discontinuity of varietal variation, (2) definite tendency in intervarietal correlation, and (3) preponderance of definite kinds of character combinations. On the ground of these facts, some consideration will be presented on intervarietal phylogenetical differentiation of the rice plant.

First, discontinuity of varietal variation will be considered: It may be a natural consequence when the character in question is determined or at least influenced mainly by a single genic change. On the other hand, when a character was influenced by a

number of genes and various kinds of individuals were to be segregated in F_2 hybrid varying continuously among them, the discontinuity of varietal variation may be regarded as proving the preponderance of definite kinds of gene combination.

According to the observation results, discontinuities of varietal variation have been pointed out distinctly in the characters as follows: pottasium chlorate resistance, low temperature resistance, drought resistance and the length of awn, and also somehow less distinctly in several characters as the weight of grain shedding, the days of germination and others.

To work out the genetical behavior of these characters may be a difficult task, but it has been demonstrated or speculated from the appearance of varietal variation that a number of genes concerns in the varietal variations of these characters. It will be concluded, therefore, that definite kinds of gene combinations are preponderant among numerous genic changes as exerting influence on these characters.

Furthermore, since different genotypes often exhibit similar phenotypes, even if varietal variation was seemingly continuous, it would not be assured that the gene combinations concerned are represented at essentially equal opportunity. Therefore, in such characters as the length-width ratio of unhulled rice which has shown continuous varietal varietal variation, the gene combinations concerned may not necessary be existent without any restraint.

Secondly, intervarietal correlations may be attributable to either of the following two cases: (a) The two characters in correlation are different expressions of an essentially same physiological character (physiological correlation), and both are influenced by the same kinds of genic change. (b) Varieties possessing defininite kinds of gene combination are predonderant over others. Among various examples of correlation given in the present study, those between characters seemingly similar in nature, such as between the length of awn and the length of glume hair, may be or may not be due to the influence of same genetical factors. It is difficult, however, to suppose that various characters all are influenced by the same genetical factors. Fursther, having divided the used varieties into two variety-groups according to the resistance against pottassium chlorate, there has been found frequently such a case that intra-group correlatious are scarcely significant in spite of marked correlations among the whole varieties. In this case, the correlation among the whole varieties will interpret that the used varieties are differentiated in the direction of the two variety-groups which are different from each other in various characters but are comparatively uniform within each.

Thirdly, this situation will be proved more clearly by the results of observations on character combination. Namely, it has been pointed out in this connection that the varieties possessing genic constitutions which express the following two kinds of phenotypes are preponderant strikingly over others: phenol reaction +, pottasium chlorate resistance —, low temperature resistance —, drought resistance +, and awn —, or the phenotype contrary in each character.

Since the used varieties has been taken out without any preconception, it will be reasonable to think that the above mentioned considerations will outline the pattern of intervarietal differentiation of the rice plant. It can be said, in short words, on the ground of the results obtained from intervarietal variation, intervarietal correlation, and character combination, well coincident inter se, that two phylogenetically differentiated variety-groups are existent among the varieties of rice plant. As mentioned in the observation results, if a proper conditional clause were added to the conception of the former Indica-Japonica classification, these two variety-groups could be regarded as corresponding to Indica and Japonica types. However, for expressing the new way of thinking on which these variety-groups have been established and their peculiar geographical distribution, it would be better to name them as "Continental" and "Insular" variety-groups.

It should be kept in mind, on the other hand, that the varieties possessing character combinations as belonging to neither of these two variety-groups have been found. These varieties, occupying extraordinary sites in correlation tables, may be of such a nature in genotype as corresponding to some recombinations between the two variety-groups.

In order to outline the whole pattern of intervarietal phylogenetical differentiation, differentiation within variety-group must be considered further. According to the observation results, within a same variety-group, discontinuitinuity of varietal variation, definite tendencies in intervarietal correlation and character combination as those found among the whole varieties have not been pointed out in regard to a greater part of characters. Various gene combinations seem to exist within variety-groups with little restraint, and intra-group differentiation will not be developped fully. In respect to several characters, however, varietal variations on a wide range have been seen within variety-group.

Especially, such characters vary remarkably within Insular variety-group as the degree of destruction of endosperm by caustic potash, the length-width ratio of unhulled rice, the length of first internode and others, which have shown no significant difference in the mode of variation between Continental and Insular variety-groups. Though variation of these characters being continuous, it has been recongized on the ground of intervarietal correlation that the varieties possessing definite character combinations such as follows are large in number: the destruction of endosperm by caustic potash being heavy, the length-width ratio of unhulled rice being small, and the first internode being short, and the combination contrary in each character. Thus, Insular variety-group seems to be divided into two minor groups, though the distinction is not so evident. The former character combination distributes mainly over the temperate regions, and the latter and other character combinations distribute mainly over the tropical regions. Therefore, a proper naming may be to call them as "Temperate Insular" and "Tropical Insular" groups.

Matsu-o (18) pointed out recently, from some observations on the combination of various morphological characters, that if the varieties of Japan, Java and India were

assumed to be the "representative types" of rice varieties, other various varieties would also be classified into these three types, and named them as A, B, and C types. His method is quite different from the authors' in his a priori fixation of "representative types", and the characters dealt with by him are also different from the authors', but so far as the ultimate result is concerned, "Continental", "Tropical Insular", and "Temperate Insular" variety-groups in the present study seems to be equivalent approximately to B, C, and A types of Mr. Matsuo respectively.

We understand little how phylogenetical differentiation of rice varieties would have developped. It will be considered as a general rule that phylogeny is due to the development of different genotypes between geographically isolated populations and the sexual isolation that follows. Intervarietal hybrid sterility which may result intervarietal sexual isolation will be dealt with in the second paper of this series of studies.

Summary

1. The aim of the present study is to gain informations as to whether definite kinds of genic constitutions would be preponderant or not among the varieties of rice plant and how the varieties are to be divided into groups. More than one hundred and twenty varieties picked out nearly randomly from numerous varieties of various districts of Eactern Asia were observed with respect to diverse characters, and on the ground of those results, discontinuity of varietal variation, intervarietal correlations and tendencies in character combination were investigated.

2. Besides phenol reaction which was found to be determined by a single genic change, the following several characters in which a number of genes would be concerned. i. e. pottasium chlorate resistance, low temperature resistance, drought resistance and the length of awn, showed discontinuous sppearances of varietal variation by which the varieties were to be divided into two groups. Varietal variations of the days of germination, and the weight of grain shedding seemed somewhat to be discontinuous. The degree of destruction of endosperm by caustic potash (alkali-test), the days of endosperm maturation, the length-width ratio of unhulled rice, the length of first and second internodes grown in a dark place, showed continuous appearance of varietal variation.

3. With regard to a greater part of these characters, except the length-width ratio of unhulled rice and length of the first and second internodes, the varieties positive in phenol reaction and the negative varieties showed characteristics contrary to each other. At the same time these characters were found to be correlated inter se.

4. With regard to each of the five characters which showed discontinuous appearance of varietal variation, i.e. phenol reaction, pottasium chlorate resistance, low temperature resistance, drought resistance, and the length of awn, the used varieties were divided into two groups, plus and minus; and thus the characteristics of a variety was represented by a combination of five signs. Then, the frequency of varieties possessing

respective kinds of character combination was investigated. Consequently, two definite kinds of character combination, namely, phenol reaction: plus, pottasium chlorate resistance and low temperature resistance: minus (weak), drought resistance: plus (hard), and awn: minus (awnless), and a character combination contrary in each to the above, were found to be preponderant among the used varieties.

5. Varieties possessing the former character combination (phenol reaction: plus, etc) were found mostly among the varieties of Asiatic Continent, viz. China, Indo-china and India, while varieties possessing the latter one were found to distribute mainly over the islands of Western Pacific, viz. Sunda Islands, Celebes, Philippine, Formosa (Horai and the native varieties of mountain part) and Japan, in addition to northern China.

6. It was considered, on the ground of various facts as mentioned above, that the varieties of rice plant were to be divided into two variety-groups which were different in various characters, reserving some indistinct varieties which would belong to neither of them. These two variety-groups were named, with a view to manifest the tendency of geographical distribution, as "Continental" and "Insular" variety-groups.

7. Within Insular group, intervarietal correlations were found among such characters as follows: the degree of destruction of endosperm by caustic potash, the length-width ratio of unhulled rice, the length of first internode, and others. Accordingly, varieties possessing definite kinds of character combination were found to be preponderant. It was considered, therefore, that Insular variety-group could be divided into two minor groups, though the distinction being not so evident. These minor groups were named as "Tropical Insular" and "Temperate Insular" variety-groups according to the tendency of geographical distribution.

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由土壤性質探討石灰氮氣之施用法

第　二　報

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作者等曾在第一報(7)中敘述：1. 氰氮化鈣之分解，在酸性緩衝力大之土壤中强盛，在此類土壤中，CN_2，HCN_2，離子之毒害輕微(1)(2)，2. 氰氮化鈣副成分之鹽基，在土壤中所生之作用，將影響於氰氮之分解與效力，其影響程度乃依土壤中游離與吸收性鹽基之含量與氰氮化鈣之施用量等而有不同。

本試驗之目的，在探討石灰氮氣在酸性與鹼性土壤中之效果，本文記載三處酸性土壤及一處鹼性土壤之水稻圃場試驗與溫室盆栽試驗，係民國三十七年一年間調查記錄，其外附以盆栽試驗土壤與收穫物化學分析。圃場部分乃作者之一陳振鐸兼任農業試驗所農業化學系主任期間辦理，其管理與調查多承林國謙技正，歐金堯、林金燦先生及新竹縣農林改良總場邱金技技正協助，誌此謹表謝忱。

一、試　驗　方　法

(一)　圃場試驗

圃場試驗在臺北農業試驗所、桃園八德、桃園東埔、臺南安南四處辦理，各試驗地土壤之理化學分析列於第一表與第二表中。

第一表　各試驗地土壤粘土含量及化學性

Table 1. Characteristics of soils

番號 No.	採 樣 地 點 Location	生成方式 Mode of formation	粘土含量 Clay content %	有機物含量 Organic matter content %	pH	鹽基置換能量 Base exchange capacity m. e. 100/gms	鹽基飽和度 Degree of base saturation %
1	桃園縣八德鎮	洪積土(紅壤)	43.08	1.69	4.75	19.11	40.87
2	桃園縣東埔鎮	洪積土(紅壤)	35.35	3.13	5.42	11.38	33.57
3	臺北市農業試驗所	冲積土	16.02	2.60	5.17	14.02	60.13
4	臺南縣安南區	海積土	12.22	0.96	7.74	7.76	96.13

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第二表　試驗土壤之化學成分(融解法全量分析)　乾土百分中%

Table 2. Chemical compositions of soils (Fusion analysis) % of oven dried soil.

土壤 Soil	水分 Moisture	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	P_2O_5	Mn_2O_3	N
1. 桃園八德	4.88	77.31	18.75	2.00	0.25	0.16	0.20	0.09	0.05	0.05
3. 桃園東埔	5.96	78.09	14.61	6.13	0.21	0.30	0.20	0.11	0.03	0.19
3. 臺北農試所	1.74	81.33	13.38	1.79	0.12	0.19	0.21	0.11	0.35	0.19
4. 臺南安南	3.50	84.58	13.87	1.58	0.17	0.26	0.13	0.09	0.14	0.19

供試土壤中，臺北農試所，桃園八德，桃園東埔土壤爲酸性冲積土與紅壤，就中八德土壤之鹽基置換力與石灰需要量最高，臺北農試所次之，臺南安南土壤爲鹼性海積土。

1. 處理：本試驗之處理，施肥量與品種列於第三表與第四表。

第三表　試驗處理及施肥量

Table 3. Kinds of treatments and amount of fertilizer applied.

處理 Treatment	記號 Sign	基肥量 Base manure Kg/Hec. N	P_2O_5	K_2O	追肥量 Top dressing N. Kg/Hec. 第一次 1 st	第二次 2 nd	第三次 3 rd	第四次 4 th
1. 硫酸錏區	$(NH_4)_2SO_4$—1	50	80	80				
2. 石灰氮氣區	$CaCN_2$—1	50	80	80				
3. 石灰氮氣倍量區	$CaCN_2$—2	100	80	80				
4. 石灰氮氣二次追肥區	$CaCN_2$—½,¼,¼	25	80	80	12.5	12.5		
5. 石灰氮氣倍量四次追肥區	$CaCN_2$—1,¼,¼,¼,¼	50	80	80	12.5	12.5	12.5	12.5

P_2O_5，K_2O 以與過燐酸石灰(16% P_2O_5)及硫酸鉀(49% K_2O)施用。

第四表　水稻品種及施肥日期

Table 4. Rice varieties and dates of applying fertilizer.

土壤 Soil	試驗地 Location of experiment	期作 Period of cropping	水稻品種 Rice varieties: 蓬萊種 Japanese varieties	本地種 Local varieties	基肥 Base manure	插秧期 Date of Transplantation	追肥 Top dressing: 第一次 1st	第二次 2nd	第三次 3rd	第四次 4th
1	桃園八德	第一期作 1 st crop	新竹八號	短廣花螺	3/12	3/18	4/7	4/17	4/27	5/6
2	桃園東埔		新竹八號		3/14	3/20	4/9	4/19	4/29	5/8
3	臺北農試所		臺中六十五號		3/16	3/22	4/11	4/21	4/31	5/10
4	臺南安南		臺南二號		6/10	6/24	7/14	7/24	8/2	8/12
1	桃園八德	第二期作 2 nd crop	新竹八號	下脚格仔	8/1	8/6	8/26	9/4	9/14	9/24
2	桃園東埔		新竹八號		8/2	8/8	8/28	9/6	9/16	9/26
3	臺北農試所		臺中六十五號		8/6	8/13	9/2	9/12	9/22	10/2
4	臺南安南									

各試驗地中除臺北農試所外，其餘三處試驗地係借用農家田地進行，因受經濟限制，處理中未列有無肥料與無氮氣區，重複則行四次，設計上有缺妥善之處。（在臺北農業試驗所所行試驗中列有無肥區及無氣區）。

2. 耕種方法：依照各地慣用法辦理。各地第一期與第二期之栽培，施肥日期，揷秧日期等列於第四表中。

3. 田間區劃：採用複因子隨機區組排列，品種有本地，蓬萊兩種，處理五，重複四，每區組含十個小區，共計四十小區。行長四公尺，行距二十五公分，株距二十公分(每行二十一株)，小區面積爲十平方公尺，其他設有邊行，保護行，水溝，田埂等。

（二） 盆栽試驗

盆栽試驗設計與管理

土壤來源：桃園八德，桃園東埔，臺北農試所，臺南安南等四處。

處理：1. 硫酸錏區〔$(NH_4)_2SO_4$—1〕，2. 石灰氮氣區〔$CaCN_2$-1〕，3. 石灰氮氣倍量區〔$CaCN_2$-2〕，4. 石灰氮氣半量爲基肥，半量分爲二次追肥區〔$CaCN_2$-$\frac{1}{2}$，$\frac{1}{4}$，$\frac{1}{4}$〕，5. 石灰氮氣倍量中，半量爲基肥，半量分爲四次追肥區〔$CaCN_2$-1，$\frac{1}{4}$，$\frac{1}{4}$，$\frac{1}{4}$，$\frac{1}{4}$〕。

重複：四次

肥料施用量：每公頃(每英畝表土以2,000.000磅計算)按施用氮五十公斤（標準量）或一百公斤（加倍量），燐酸八十公斤，鉀八十公斤爲基準之比例，每鉢十五公斤土壤中施用氮 0.33克(標準量）或 0.66 克（加倍量），燐酸 0.53 克，鉀 0.53 克，氮用硫酸錏（20%N）或石灰氮氣(19.5%)，燐酸用過燐酸石灰(16% P_2O_5)，鉀用硫酸鉀（49% K_2O）。每次石灰氮氣追肥用量爲氮(N)0.08克。

品種：蓬萊種，臺中六十五號。本地種，短廣花螺。

施肥日期：基肥 3 月22日，追肥第一次 4 月18日，第二次 4 月28日，第三次 5 月 8 日，第四次 5 月18日。

揷秧期： 3 月28日

管理：晴天時移入於網室內，雨天及夜間放入玻璃室內，灌溉定量水分，並按期行中耕除草。

二、試 驗 結 果

（一） 圃場試驗

在本試驗中曾測定各地各小區水稻藁稈高度，分蘗數等，又在收穫後秤量精穀與藁稈風乾物重量。玆將各處理四小區精穀收量平均數以公斤/公頃計算者列於第五表中。

第五表　各處理四區精穀收量平均數（公斤/公頃）

Table 5. Yields in grain of various treatments. Averages of four plots. (Kg/Hec.)

處理 Treatments	期作 Period of cropping	桃園八德 Soil No.1 蓬萊種 Japanese variety	桃園八德 Soil No.1 本地種 Local variety	桃園東埔 Soil No.2 蓬萊種 Japanese variety	桃園東埔 Soil No.2 本地種 Local variety	臺北農業試驗所 Soil No.3 蓬萊種 Japanese variety	臺北農業試驗所 Soil No.3 本地種 Local variety	臺南安南 Soil No.4 蓬萊種 Japanese variety	臺南安南 Soil No.4 本地種 Local variety
1. [$(NH_4)_2SO_4$—1]	第一期作 1 st Crop	2870	2182	3116	3241	2426	2278	3110	3460
2. [$CaCN_2$—1]		3001	1891	3241	3266	2566	2354	2780	3120
3. [$CaCN_2$—2]		2565	2544	3650	3606	2886	2891	2995	3440
4. [$CaCN_2$—½,¼,¼]		2611	2309	3057	3252	2206	2274	2930	3380
5. [$CaCN_2$—1,¼,¼,¼,¼]		2089	2289	3261	2354	2141	2645	3550	3740
1. [$(NH_4)_2SO_4$—1]	第二期作 2 nd Crop	1970	2044	2448	2326	1248	1100	—	—
2. [$CaCN_5$—1]		2258	1890	2209	2244	1249	1191	—	—
3. [$CaCN_2$—2]		2327	2390	2235	2463	1560	1280	—	—
4. [$CaCCN_2$—½,¼,¼]		2153	2138	2026	2279	911	976	—	—
5. [$CaCN_2$—1,¼,¼,¼,¼]		2196	1966	2004	2347	324	534	—	—

嗣依 Fisher 變量分析法(6)計算機差，測定處理均方及區集均方之顯著性，本試驗各處理區集精穀收量間差異顯著標點列於第六表中。

第六表　各處理間差異顯著標點（公斤/公頃）

Table 6. Yields in grain at 5% and 1% levels of significance. (Kg/Hec.)

顯著標點 Level of significance	桃園八德 Soil No. 1 第一期作 1st Crop	桃園八德 Soil No. 1 第二期作 2nd Crop	桃園東埔 Soil No. 2 第一期作 1st Crop	桃園東埔 Soil No. 2 第二期作 2nd Crop	臺北農試所 Soil No. 3 第一期作 1st Crop	臺北農試所 Soil No. 3 第二期作 2nd Crop	臺南安南 Soil No. 4 中間作 Intermediate Crop
5%	365.4 △	214.3	169.0	146.5	220.0	182.6	244.2
1%	493.4 △	289.4	228.3	197.8	297.1	246.6	329.8

△桃園八德第一期作處理間差異不顯著，而所列之數字爲品種與處理間連應顯著差異需要值。其他試驗處理間差異均顯著，所列者爲處理間顯著差異需要值。

(二) 盆栽試驗

盆栽試驗中觀測水稻出穗期，成熟期，稈高，分蘖數，穀實重，藁稈重，又在收穫後行土壤，穀實與藁稈中氮含量之分析，其所得結果列於第七表中。

第七表　盆栽試驗成績表（民國三十七年第一期作）

Table 7. Results of pot experiment

土壤 Soil	桃園八德 Soil 1									
品種 Varieties	蓬萊種 Japanese Variety					本地種 Local Variety				
處理 Treatment	$(NH_4)_2SO_4$	$CaCN_2$—1	$CaCN_2$—2	$CaCN_2$—½ ¼, ¼	$CaCN_2$—1 ¼,¼,¼,¼	$(NH_4)_2SO_4$	$CaCN_2$—1	$CaCN_2$—2	$CaCN_2$—½ ¼,¼	$CaCN_2$—1 ¼,¼,¼,¼
出穗期 Date of heading 月日	6.29.	6.29.	6.29.	6.29.	6.29.	6. 5.	6. 5.	6. 5.	6. 5.	6. 5.
	6.29.	6.29.	6.29.	6.29.	6.29.	6. 5.	6. 5.	6. 5.	6. 6.	6. 6.
平均	6.29.	6.29.	6.29.	6.29.	6.29.	6. 5.	6. 5.	6. 5.	6. 6.	6. 6.
成熟期 Date of maturity 月日	8. 2.	8. 4.	8. 5.	8. 5.	8. 9.	7. 5.	7. 5.	7. 5.	7. 5.	7. 5.
	8. 5.	8. 5.	8. 5.	8. 9.	8. 5.	7. 5.	7. 5.	7. 5.	7. 5.	7. 5.
平均	8. 4.	8. 5.	8. 5.	8. 7.	8. 7.	7. 5.	7. 5.	7. 5.	7. 5.	7. 5.
稈高 Length of culm (cm.)	63	60	67	65	66	64	70	70	58	56
	64	64	62	64	65	64	67	67	47	63
平均	63.5	62.0	64.5	64.5	65.5	64.0	68.5	68.5	52.5	59.5
分蘗 Number of culms	16	17	20	16	17	13	17	16	12	14
	23	16	20	16	24	15	16	20	17	17
平均	19.5	16.5	20.0	16.0	20.5	14.0	16.5	18.0	14.5	15.5
穀實重量 Weight of grain (g.)	22.3	20.5	25.2	26.8	20.8	21.5	25.9	31.2	21.7	27.6
	21.8	20.8	30.1	24.7	29.4	25.1	27.3	28.7	30.0	25.8
平均	22.1	20.7	27.7	25.8	25.1	23.3	26.6	30.0	25.9	26.7
藁稈重量 Weight of straw (g.)	58.9	62.5	76.2	71.8	62.1	47.9	35.0	31.2	25.5	28.4
	76.5	48.3	59.5	59.8	83.2	25.9	33.1	33.9	39.6	33.2
平均	67.7	55.4	67.9	65.8	72.7	36.9	34.1	34.1	32.6	30.8
土壤中氮含量 N % in oven dried soil	0.17	0.16	0.16	0.16	0.16	0.26	0.25	0.25	0.26	0.25
	0.18	0.19	0.15	0.19	0.16	0.26	0.23	0.24	0.31	0.36
平均	0.18	0.18	0.16	0.18	0.16	0.26	0.24	0.25	0.29	0.31
穀實中氮含量 N % in grain (dry matter)	2.88	2.95	2.98	2.93	2.94	1.66	1.68	1.79	1.94	1.99
	2.97	2.96	2.98	2.97	2.97	1.84	1.77	1.86	1.61	2.05
平均	2.93	2.96	2.98	2.95	2.96	1.75	1.73	1.83	1.78	2.02
藁桿中氮含量 N % in straw (dry matter)						2.99	2.73	3.00	3.00	2.99
						2.94	2.93	2.94	2.94	2.94
平均						2.97	2.83	2.97	2.97	2.97

第七表 盆栽試驗成績表 (民國三十七年第一期作) (續)

Table. 7. Results of pot experiment (Continued)

土壤 Soil	桃園東埔 Soil 2									
品種 Varieties	蓬萊種 Japanese Variety					本地種 Local Variety				
處理 Treatment	$(NH_4)_2SO_4$	$CaCN_2$—1	$CaCN_2$—2	$CaCN_2$—½ ¼, ¼	$CaCN_2$—1 ¼,¼,¼,¼	$(NH_4)_2SO_4$	$CaCN_2$—1	$CaCN_2$—2	$CaCN_2$—½ ¼, ¼	$CaCN_2$—1 ¼,¼,¼,¼
出穗期 Date of heading 月 日	6.28.	6.28.	6.28.	6.28.	6.28.	6. 5.	6. 5.	6. 5.	6. 5.	6. 6.
	6.27.	6.28.	6.28.	6.29.	6.29.	6. 5.	6. 5.	6. 5.	6. 5.	6. 6.
平均	6.28.	6.28.	6.28.	6.29.	6.29.	6. 5.	6. 5.	6. 5.	6. 5.	6. 6.
成熟期 Date of maturity 月 日	7.28.	8. 2.	8. 5.	8. 9.	8. 9.	7. 5.	7. 5.	7. 5.	7. 5.	7. 5.
	7.28.	8. 9.	8. 5.	8. 4.	8. 9.	7. 5.	7. 5.	7. 5.	7. 5.	7. 5.
平均	7.28.	8. 6.	8. 5,	8. 7.	8. 9.	7. 5.	7. 5.	7. 5.	7. 5.	7. 5.
稈高 Length of culm. (cm.)	63	70	70	66	62	71	63	70	65	70
	63	67	62	63	59	68	70	71	71	70
平均	63.0	68.5	66.0	64.5	60.5	69.5	66.5	70.5	68.0	70.0
分蘗 Number of culms	16	16	16	17	17	17	12	18	12	16
	15	19	17	17	18	16	16	19	15	16
平均	15.5	17.5	16.5	17.0	17.5	16.5	14.0	18.5	13.5	16.0
穀實重量 Weight of grain (g.)	25.8	27.4	29.3	30.2	32.2	30.4	18.6	38.4	26.2	31.3
	24.8	32.4	22.8	27.4	28.2	30.5	25.7	34.0	30.2	27.5
平均	25.3	29.9	26.1	28.8	30.2	30.5	22.2	36.2	28.2	29.4
藁桿重量 Weight of straw (g.)	55.3	45.9	53.5	58.8	77.5	36.5	29.9	43.3	30.4	34.2
	42.1	70.9	50.7	61.0	61.0	35.0	32.0	36.7	37.1	35.9
平均	48.7	58.4	52.1	59.9	69.3	35.8	31.0	40.0	33.8	35.1
土壤中氮含量 N % in oven dried soil	0.16	0.15	0.16	0.15	0.15	0.23	0.27	0.24	0.26	0.24
	0.14	0.13	0.15	0.15	0.15	0.23	0.23	0.22	0.21	0.23
平均	0.15	0.14	0.16	0.15	0.15	0.23	0.25	0.23	0.24	0.24
穀實中氮含量 N % in grain (dry matter)	2.91	2.99	2.96	2.97	3.06	1.62	1.96	1.61	1.78	1.78
	2.86	2.93	2.95	2.88	2.87	1.85	1.64	1.76	1.79	1.76
平均	2.89	2.96	2.96	2.93	2.97	1.74	1.80	1.69	1.79	1.77
藁桿中氮含量 N % in straw (dry matter)	0.86	0.58	0.60	0.83	0.81	2.94	3.01	2.95	2.97	2.98
	0.80	0.73	0.68	0.70	0.76	2.97	2.98	2.98	2.98	3.03
平均	0.83	0.66	0.64	0.77	0.79	2.96	3.00	2.97	2.98	3.01

第七表　盆栽試驗成績表（民國三十七年第一期作）（續）

Table. 7 Results of pot experiment (Continued)

土壤 Soil		臺北農試所 Soil 3									
品種 Varieties		蓬萊種 Japanese Variety					本地種 Local Variety				
處理 Treatment		$(NH_4)_2SO_4$	$CaCN_2$—1	$CaCN_2$—2	$CaCN_2$—½ ¼, ¼	$CaCN_2$—1 ¼,¼,¼,¼	$(NH_4)_2SO_4$	$CaCN_2$—1	$CaCN_2$—2	$CaCN_2$—½ ¼, ¼	$CaCN_2$—1 ¼,¼,¼,¼
出穗期 月 日 Date of heading		6.28.	6.28.	6.28.	6.28.	6.29.	6. 4.	6. 5.	6. 5.	6. 5.	6. 5.
		6.28.	6.28.	6.28.	6.29.	6.29.	6. 6.	6. 7.	6. 5.	6. 5.	6. 5.
	平均	6.28.	6.28.	6.28.	6.29.	6.29.	6. 5.	6. 6.	6. 5.	6. 5.	6. 5.
成熟期 月 日 Date of maturity		7.28.	7.28.	7.28.	7.28.	8. 2.	7. 2.	7. 2.	7. 2.	7. 2.	7. 2.
			7.28.	7.30.	8. 4.	8. 4.	7. 2.	7. 2.	7. 2.	7. 2.	7. 2.
	平均	7.28.	7.28.	7.29.	8. 1.	8. 3.	7. 2.	7. 2.	7. 2.	7. 2.	7. 2.
稈高 Length of culm. (cm.)		63	65	71	68	65	72	75	73	72	78
		69	65	69	68	69	65	74	75	79	67
	平均	66.0	65.0	70.0	68.0	67.0	68.5	74.5	74.0	75.5	72.5
分蘗 Number of culms		16	17	22	20	23	15	15	15	15	22
		16	16	22	13	23	17	11	17	17	19
	平均	16.0	16.5	22.0	16.5	23.0	16.0	13.0	16.0	16.0	20.5
穀實重量 Weight of grain (g.)		29.6	19.8	32.4	40.5	38.2	29.5	29.5	29.0	30.5	46.1
			28.2	25.4	21.3	32.2	26.6	22.1	34.3	31.5	38.3
	平均	29.6	24.0	28.9	30.9	35.2	28.1	25.8	31.7	31.0	42.2
藁稈重量 Weight of straw (g.)		53.0	59.0	67.7	58.2	65.9	40.9	40.5	40.1	42.9	53.3
			58.2	64.3	39.4	86.0	36.9	36.2	51.1	39.5	49.4
	平均	53.0	58.6	66.0	48.8	76.0	38.9	38.4	45.6	41.2	51.4
土壤中氮含量 N % in oven dried soil		0.22	0.21	0.21	0.21	0.22	02.8	0.26	0.26	0.26	0.25
		0.22	0.21	0.22	0.21	0.19	0.27	0.28	0.26	0.24	0.23
	平均	0.22	0.21	0.22	0.21	0.21	0.28	0.27	0.26	0.25	0.24
穀實中氮含量 N % in grain (dry matter)		2.91	2.95	3.07	3.02	2.99	1.61	1.45	1.58	1.50	1.48
			3.01	3.03	2.97	3.00	1.50	1.63	1.46	1.50	1.45
	平均	2.91	2.98	3.05	3.00	3.00	1.56	1.54	1.52	1.50	1.47
藁稈中氮含量 N % in straw (dry matter)		0.95	0.83	0.72	0.80	0.69	3.07	3.03	3.01	3.01	3.00
			0.61	0.82	0.78	0.82	2.88	2.98	2.98	2.90	2.99
	平均	0.95	0.72	0.77	0.79	0.76	2.98	3.01	3.00	2.96	3.00

第七表 盆栽試驗成績表（民國三十七年第一期作）（續）

Table. 7 Results of pot experiment (Continued)

土壤 Soil	臺南安南 Soil 4									
品種 Varieties	蓬萊種 Japanese Variety					本地種 Local Variety				
處理 Treatment	$(NH_4)_2SO_4$	$CaCN_2$—1	$CaCN_2$—2	$CaCN_2$—½ ¼, ¼	$CaCN_2$—1 ¼,¼,¼,¼	$(NH_4)_2SO_4$	$CaCN_2$—1	$CaCN_2$—2	$CaCN_2$—½ ¼, ¼	$CaCN_2$—1 ¼,¼,¼,¼
出穗期 Date of heading 月 日	7. 4.	7. 4.	7. 4.	7. 4.	7. 4.	6. 5.	6. 5.	6. 5.	6. 6.	6. 6.
	7. 4.	7. 4.	7. 4.	7. 4.	7. 4.	6. 5.	6. 5.	6. 5.	6. 5.	6. 5.
平均	7. 4.	7. 4.	7. 4.	7. 4.	7. 4.	6. 5.	6. 5.	6. 5.	6. 6.	6. 6.
成熟期 Date of maturity 月 日	7.28.	7.28.	8. 4.	7.28.	7.28.	7. 3.	7. 3.	7. 3.	7. 3.	7. 3.
	7.28.	7.28.	7.28.	7.28.	7.28.	7. 3.	7. 3.	7. 3.	7. 3.	7. 3.
平均	7.28.	7.28.	8. 1.	7.28.	7.28.	7. 3.	7. 3.	7. 3.	7. 3.	7. 3.
稈高 Length of culm. (cm.)	57	59	48	60	59	64	60	68	70	60
	56	59	60	61	67	68	78	58	62	71
平均	56.5	59.0	54.0	60.5	63.0	66.0	69.0	63.0	66.0	65.5
分蘖 Number of culms	11	10	14	12	12	9	5	9	6	11
	11	9	14	10	9	8	8	11	7	10
平均	11.0	9.5	14.0	11.0	10.5	8.5	6.5	10.0	6.5	10.5
積實重量 Weight of grain. (g.)	14.8	12.8	6.4	10.4	12.2	15.0	7.6	15.7	14.2	22.0
	15.3	10.8	17.2	18.5	15.6	11.5	13.7	21.3	12.5	21.9
平均	15.1	11.8	11.8	14.5	13.9	13.3	10.7	18.5	13.4	22.0
藁稈重量 Weight of straw (g.)	30.2	23.7	30.9	36.3	41.8	23.9	19.6	16.9	18.8	29.8
	28.9	27.4	45.1	36.0	37.0	27.2	22.8	30.2	20.6	29.8
平均	29.6	25.6	38.0	36.2	39.4	25.6	21.2	28.6	19.7	29.8
土壤中氮含量 N % in oven dried soil	0.15	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.16
	0.15	0.15	0.17	0.17	0.15	0.15	0.16	0.15	0.16	0.15
平均	0.15	0.15	0.17	0.17	0.16	0.16	0.16	0.16	0.17	0.16
穀實中氮含量 N % in grain (dry matter)	1.26	1.70	1.58	1.30	1.18	1.38	1.34	1.48	1.24	1.24
	1.47	1.58	1.64	1.31	1.40	1.23	1.37	1.23	1.37	1.27
平均	1.37	1.64	1.61	1.31	1.29	1.31	1.36	1.36	1.31	1.26
藁稈中氮含量 N % in straw (dry matter)	1.95	1.80	1.94	1.88	1.79	2.95	2.95	2.96	2.94	2.93
	1.67	1.78	1.93	1.81	1.85	2.95	2.96	2.94	2.96	2.96
平均	1.81	1.79	1.94	1.85	1.82	2.95	2.96	2.95	2.95	2.95

三、討　　論

(一) 圃場部分

就臺北，桃園等處酸性土壤中施用石灰氰氮與硫酸錏之效果而言，在十二個期作與品種不同試驗中十個試驗之石灰氰氮區收量與硫酸錏區收量間差異均不顯著。僅有二個試驗之硫酸錏區與石灰氰氮區間收量差異顯著；此二者爲(一)桃園八德第二期作蓬萊種收量，石灰氰氮區多於硫酸錏區288公斤/公頃差異顯著 (5%標點)，(二)東埔第二期作蓬萊種，硫酸錏區多於石灰氰氮區239公斤/公頃，差異顯著 (1%標點)，以上二試驗結果，吾人似可視之爲非一般性，因於試驗土壤中，在多數情形，石灰氰氮與硫酸錏在第一年試驗中，效果近似也。茲將各試驗地石灰氰氮與硫酸錏區之收量差異列於第八表中。

第八表　硫酸錏區與石灰氰氮區收量差異

Table 8. Difference in yields of grain between ammonium sulphate and calcium cyanamide plot. (Kg/Hec.)

桃園八德 Soil No. 1				桃園東埔 Soil No. 2				臺北農試所 Soil No. 3			
第一期作 1 st Crop		第二期作 2 nd crop		第一期作 1 st Crop		第二期作 2 nd Crop		第一期作 1 st Crop		第二期作 2 nd Crop	
蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.
—131	291	* —288	154	—125	—25	** 239	82	—140	—76	—1	—91

* 5% significence

** 1% significence

負號表示石灰氰氮區收量高於硫酸錏區

Minus sign indicates the yield in grain of calcium cyanamide plot is higher than that of ammonium sulphate plot.

在本試驗土壤中增加石灰氰氮氮量五十公斤後(即施用量爲一百公斤氮量後)所得增收量列於第九表中。

第九表　石灰氰氮氮50公斤/公頃區與100公斤/公頃區收量差異

Table 9. Difference in yields of grain between the plot added 50 Kg/Hec. N and 100 Kg/Hec. N of calcium cyanamide

	桃園八德 Soil No. 1				桃園東埔 Soil No. 2				臺北試所 Soil No. 3			
	第一期作 1 st Crop		第二期作 2 nd Crop		第一期作 1 st Crop		第二期作 2 nd Crop		第一期作 1 st Crop		第二期作 2 nd Crop	
	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.
收量差異 Difference in yield	* —436	** 653	69	** 500	** 409	** 340	26	** 219	** 320	** 537	** 311	89
100公斤/公頃氮區收量指數 (50公斤/公頃氮區收量爲100) Index figure of yield in 100Kg/Hec N plot, (yield of 50Kg/Hec. N plot: 100)	85	134	103	126	112	110	101	109	112	122	124	107

負號示50公斤/公頃氮區收量多於100公斤/公頃氮區收量

Minus sign indicates the yield in grain of 50Kg/Hec N plot is higher than that of 100Kg/Hec N plot.

桃園八德第一期作蓬萊種石灰氮氣加倍量區曾受颱風損害

[$CaCN_2$—2] plot of the 1 st crop, Japanese variety of Soil No. 1 was damaged by the storm.

在第九表十二個試驗中，有三個試驗示加用五十公斤氮量後穀實之增收量不達5％顯著標點，而有八個試驗結果示，加用五十公斤氮量後，收量差異皆達1％顯著標點，其增收量在二百十九公斤至六百五十三公斤之間，變幅頗大。本試驗之期間旣短，地點嫌小，故由試驗成績尚難查定在氮氣爲限制因素 Limiting Factor 之普通酸性土壤中，其鹽基置換力，鹽基不飽和度大小與石灰氮氣肥效間關係，惟由本試驗可知在土壤供應氮氣條件相同情形下，在酸性，鹽基置換力大，不飽和程度大，石灰需要量大之土壤中(如桃園八德，臺北農試所土壤)，石灰氮氣之效果概大。在酸性土壤中照農民施肥方式（加用相當量有機質肥料），倘繼續施用硫酸錏或石灰氮氣，則兩者在收量上究發生若何差異，土壤性狀如何變化等尚待於今後之硏究。

臺南安南鹼性土壤中，施用石灰氮氣與硫酸錏試驗成績示，石灰氮氣五十公斤氮量區收量遜於同氮量硫酸錏區，兩區中間作(一年植一次)蓬萊種收量差異爲330公斤/公頃，本地種差異爲340公斤/公頃，兩者差異均在1％標點。本試驗又示將石灰氮氣氮量加至一百公斤後，蓬萊種收量較同肥料五十公斤氮區增加215公斤/公頃(差異不顯著)，本地種收量增加320公斤/公頃(差異顯著達5％標點)，此時兩品種產量始接近於硫酸錏氮五十公斤區收量，惟仍未能超過之。硫酸錏五十公斤氮區與石灰氮氣一百公斤氮區，蓬萊種收量差異爲115公斤/公頃，本地種收量差異爲20公斤/公頃（差異均不顯著）。以上成績顯示，在本試驗鹼性土壤中，石灰氮氣之效力遜於硫酸錏。施用石灰氮氣於鈉成分高之鹼性土壤時，土壤滲透性等可以改善，惟因鹼性提高，可能妨害作物生長與肥料分解，故就其施用方法需要注意耳。

石灰氮氣施用法中，值得普遍推廣於農民者，爲混合石灰氮氣於新鮮堆肥中，俟腐熟後作爲基肥，在水稻移植前十日至一星期間施用(8)。本法可避免直接施用石灰氮氣後產生之 HCN_2，CN_2 離子毒害作用，同時又可藉石灰氮氣中氮與鹽基之作用，促進堆肥腐熟，誠爲良法也。在本試驗中特別加入石灰氮氣追肥區，並非自應用立場着眼，其用意乃欲觀察在反應不同土壤中，直接施入石灰氮氣對於水稻收量之影響耳。在本試驗中採用之追肥處理爲，1. 石灰氮氣二次追肥區（全期施用氮量爲五十公斤/公頃），2. 石灰氮氣四次追肥區(全期施用氮量爲一百公斤/公頃)。每次追肥施用量則爲12.5公斤/公頃氮量，作者等在第一報試驗中(7)曾測定，倘直接施用此分量石灰氮氣氮量時，水稻不致被害致死，惟視土壤分解 HCN_2，CN_2 能力之强弱及水分，溫度等影響之大小，水稻生育乃受不同程度之被害。

各試驗地，各期作五十公斤量基肥區與同氮量二次追肥區收量差異以及一百公斤氮量基肥區與同氮量四次追肥區收量差異列於第十表。

第十表　石灰氮氣基肥區與追肥區之收量差異（公斤/公頃）

Table 10. Difference in yields of grain between the plot fertilized with calcium cyanamide as a base manure and as a top dressing. (Kg/Hec.)

	桃園八德 Soil No. 1				桃園東埔 Soil No. 2				臺北農試所 Soil No. 3			
	第一期作 1 st Crop		第二期作 2 nd Crop		第一期作 1 st Crop		第二期作 2 nd Crop		第一期作 1 st Crop		第二期作 2 nd Crop	
	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.
石灰氮氣50公斤氮量基肥區與同氮量二次追肥區收量差異 Difference in yield between the plot 2, [$CaCN_2$—1] and 4 [$CaCN_2$—½, ¼, ¼]	* 390	* —418	105	* —248	* 184	14	* 183	—35	** 361	80	** 338	* 215

石灰氮氣 100 公斤氮量基肥區與同氮量四次追肥區收量差異 Difference in yield between the plot 3[$CaCN_2$—2] and 5[$CaCN_2$—1, ¼, ¼, ¼, ¼	* 476	255	131	** 424	** 389	** 252	** 231	116	** 745	* 246	** 1238	** 746

負號示追肥區收量高於基肥區

Minus sign indicates the yield in grain of the plot fertilized with calcium cyanamide as a top dressing is higher than that applied the same fertilizer as a base manure.

由上表便知，在酸性土壤中，施用五十公斤氮量時，在十二試驗中，兩個試驗之追肥區收量大於基肥區（差異顯著標點5%），四個試驗，基肥區與追肥區收量之差異不顯著，六個試驗，基肥區收量大於追肥區（差異顯著標點 1 %或 5 %）。又施用一百公斤氮量時，在十二個試驗中，三個試驗爲基肥區與追肥區間收量差異不顯著，九個試驗爲基肥區收量多於追肥區（差異顯著標點在 1%或 5%），以上結果示知，基肥區與追肥區間收量差異在石灰氮氣施用量增加及追肥次數增加時增多。

由本試驗成績尙難推定追肥法效果與土壤粒構，鹽基置換能量，石灰需要量等關係，唯在粘土含量多，鹽基置換能量大，石灰需要量大之桃園八德土壤中直接施用適量石灰氮氣後，其被害較輕微。水田中直接施用石灰氮氣時除可收一般追肥之效用外且兼有除草殺蟲效用(3) (4) (5)，唯就其用量，時期，效率等問題宜待研究。

鹼性土壤中追肥法試驗則示，在各區收量中，一百公斤氮量四次追肥區爲最高，一百公斤氮量基肥區次之，而五十公斤氮量基肥區爲最低。蓬萊種與本地種得同樣結果。本試驗各區收量與各區間差異列於第十一表中。

第十一表　石灰氮氣基肥區與追肥區之收量差異（公斤/公頃）

Table 11. Difference in yields of grain between the plot fertilized with calcium cyanamide as a base manure and as a top dressing. (Kg/Hec.)

處理 Treatment	蓬萊種 Japanese Variety				本地種 Local Variety			
	收量 Mean yield in grain	差異 Difference			收量 Mean yield in grain	差異 Difference		
一百公斤氮四次追肥區 $CaCN_2$—1, ¼, ¼, ¼, ¼	3,550				3,740			
一百公斤氮基肥區 $CaCN_2$—2	2,995	555**			3,440	300*		
五十公斤氮二次追肥區 $CaCN_2$—½, ¼, ¼	2,930	620**	65		3.380	360**	60	
五十公斤氮基肥區 $CaCN_2$—1	2,780	770**	215	150	3,120	620**	320**	260*

由上可知在鹼性土壤中增加氮氣肥料施用量以圖增收時，追肥法之效力大。至於在本試驗中追肥法爲優之理由可推測如下。1. 在鹼性土壤中一次施用較多量石灰氮氣時，因鹽基增多，引起鹼性加重，阻滯石灰氮氣之分解，加重 CN_2，HCN_2 離子之毒性，阻害土壤微生物作用及減少土壤中有效養料溶解性等之現象，以損害水稻之正常發育。2. 本試驗之鹼性土壤粘土成分低，有機物含量少，而中間作水稻之生育期間長。氣溫又高，在此等情形下追肥法之氮氣損失量可能低於基肥法，故其利用效率高。

本省中南部鹼性土壤農耕地公佈面積不少，故研究鹼性土壤中施用肥料方法之重要性當不亞於酸性土壤中施用肥料法之重要性。

（二） 盆栽部份

本文盆栽試驗，係一種預備試驗，僅有指示傾向之意義，茲將其各處理區榖實收量平均數之指數列於第十二表，以供參考。

第十二表 盆栽試驗各處理區榖實收量指數

Table 12. Index figures of the yields in grain of the pot experiment

處理 Treatment soil	桃園八德 Soil No. 1		桃園東埔 Soil No. 2		臺北農試所 Soil No. 3		臺南安南 Soil No. 4	
	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.	蓬萊種 J. V.	本地種 L. V.
[$CaCN_2$—1]	100	100	100	100	100	100	100	100
[$(NH_4)_2SO_4$—1]	106	87	84	137	123	108	127	124
[$CaCN_2$—2]	133	112	87	163	120	122	100	172
[$CaCN_2$—½, ¼, ¼]	124	97	96	127	128	120	122	125
[$CaCN_2$—2]	100	100	100	100	100	100	100	100
[$CaCN_2$—1, ¼, ¼, ¼]	90	89	115	81	121	133	117	118

盆栽試驗成績無圃場試驗之詳細及明顯，唯在本試驗中所得概念如下：

1. 三種酸性土壤中試驗成績示，硫酸錏與石灰氮氣之效力，以何者爲優，不能斷言。

2. 無論蓬萊種或本地種，在桃園八德或臺北農試所之土壤中栽培時，加用石灰氮氣之效果均大。

3. 施用標準量石灰氮氣時，就基肥法與二次追肥法而比較收量之優劣，則在臺北農試所土壤中，蓬萊種與本地種之榖實收量，均以追肥法高於基肥法。

4. 施用倍量石灰氮氣時，在桃園八德土壤中，基肥法收量高於四次追肥法，在桃園東埔土壤中，兩法收量優劣不明，在臺北農試所土壤中，則以追肥法收量爲高。

5. 在臺南安南之鹼性土壤中，施用同量之硫酸錏與石氮灰氣時，不論栽培品種爲蓬萊種或本地種，硫酸錏區之收量，均高於石灰氮氣區。又增高石灰氮氣之用量，並分期施用時，蓬萊種或本地種之收量均有增高趨向。

如上除臺北農試所土壤，基肥法及追肥法成績與圃場試驗中所得者有出入外，其他酸性土壤成績尙與圃場試驗結果符合，至於鹼性土壤盆栽試驗結果則與圃場試驗成績相符。

（三） 土壤與收穫物榖實，藁稈中氮含量。

在收穫水稻後，曾測定各試驗土壤，各處理區之氮含量，分析結果列於第七表中，該表示不同供試土壤經相同處理與栽培後，在各土壤含氮量上產生差異，（供試土壤原有含氮量列於第二表中，各土壤原有氮量除桃園八德外幾無差異）。 但同一土壤經本試驗不同處理與同一栽培處置後，在含氮量上尙無差異。由本試驗又可知供試酸性土壤中經栽培蓬萊種與本地種後，在土壤含氮量上有產生差異傾向，就中經栽培本地種者含有較高氮量。以上諸結果表明在本試驗中，水稻吸收氮氣之效率受土壤性

質與栽培品種之影響甚大也。

四、結　　論

一、本文記載在三處酸性土壤，一處鹼性土壤中石灰氮氣與硫酸錏對水稻之肥效比較試驗及石灰氮氣施用法試驗。

二、圃場試驗與盆栽試驗成績，大體上符合。

三、在本試驗之酸性土壤中，石灰氮氣與硫酸錏之效果略同。兩者水稻穀實之收量間無顯著差異，但在鹼性土壤中硫酸錏區收量高於石灰氮氣區。

四、石灰氮氣適用於酸性，緩衝力大，鹽基置換能量大，鹽基不飽和度大，石灰需要量高之土壤中，在此類土壤中施用石灰氮氣後增收之可能性較大。

五、在鹼性土壤中，栽培生育期間長的中間作水稻，而以四次追肥法施用石灰氮氣時，其收量高於以同量石灰氮氣作基肥施用者。兩者收量差異顯著。

六、以本試驗土壤分析與收穫物分析資料爲根據，在本文中論述土壤性質與作物品種對於肥料試驗成績檢討與解釋上之重要性。

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A STUDY ON THE APPLICATION OF CALCIUM CYANAMIDE TO SOILS (II)

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Summary

It has been observed in the previous investigation, that the rate of CN_2, HCN_2 ions removal were more rapid from an acid soil with high buffer capacity, and the toxicity thus induced by this fertilizer may be accordingly reduced. It was also stated that for a soil with high exchange capacity, high percentage of base unsaturation and high lime requirement value, a greater effect through the application of calcium cyanamide may be expected.

In the present investigation, both field and pot experiments of rice with various treatments of calcium cyanamide and sulfate of ammonia, as shown in Table 3, were made with three acid soils and one alkali soil. The physical and chemical properties of these soils are tabulated in Table 1 and 2. The yields in grain and straw from the experimental prots were analyzed statistically and investigated. The results thus obtained may be summarized as follows:

1. Similar results were obtained in both of the field and pot experiments. The field experiment, however, gave a more significant and concrete values than those of the pot experiment.
2. In acid soils, no significant difference may be found between the yields of calcium cyanamide plot and those of the ammonium sulfate plot of which the similar quantities of nitrogen were applied. While in the alkali soil, the yield of ammonium sulphate plot was found to be significantly higher than that of the calcium cyanamide plot. It was also found in the field experiment of alkali soil that by doubling the amount of calcium cyanamide, the yield was increased and no remarkable toxicity effect due to the added alkalinity may be observed. No diffence in the yield between this plot and that of ammonium sulphate with only half of nitrogen applied also may be noticed.
3. The rate of increase in yield through the additional supply of calcium cyanamide was comparatively greater in an acid soil with high exchange capacity and high lime requirement value.

4. In the alkali soil, applying calcium cyanamide as a top dressing manure gave a significantly higher yield than applying this fertilizer as a base manure. This may probably due to two reasons: 1. Applying one forth of the amount of calcium cyanamide in one time as a top dressing may reduce the toxicity of cyanamide in the alkali soil. 2. Reducing the loss of nitrogen in the experiment field which is low in clay and humus content.

水稻施用石灰示範試驗報告*

張守敬　　黃國瑞

試驗目的及設計

臺灣酸性土壤上施用石灰，據過去數年田間試驗之結果，在大多情形下，可增加水稻穀及藁之產量。[1][2] 本試驗之目的，(1)在廣泛地獲得石灰對於水稻產量影響之資料，並(2)作爲對農家之示範。

試驗於1950年二期作及1951年一期作舉行。

1950年二期作試驗，因進行時間較遲，設計未能統一，設計有二種：

I. 包括三處理：(1) 無石灰，(2) 石灰基肥 3 噸/公頃，(3) 石灰追肥 3 噸/公頃，栽植蓬來種水稻或在來種水稻。

II. 包括三處理：(1)無石灰，(2)石灰追肥 2 噸/公頃，(3) 石灰追肥 3 噸/公頃。

試區面積爲一公畝，每小區皆隨機排列，重複一次，或無重複。石灰基肥在挿秧前五天施用，追肥在分蘗最盛時施用，約在挿秧後30—40天，其他一切田間操作均與農家習慣同。

1951年一期作之試驗設計，包括二處理：(1) 無石灰，(2) 石灰基肥 3 噸/公頃，小區面積爲半公畝，六次重複，二處理順序相間排列，石灰基肥在挿秧前五天施用，其他田間操作，皆照農家習慣。

本報告之目的，只在提出產量數據以明臺灣北部酸性土壤上施用石灰後對於水稻增產之可能性，至石灰效果與土壤性質之關係則容後討論。

試驗結果之檢討

1950 及1951 二次試驗田之土壤，包括紅壤，(湖口，桃園，蘆竹，八德，楊梅，中壢)，黃壤，(汐止) 及沙岩、頁岩質冲積土 (新竹、竹南、頭分、新莊)，其中紅壤及黃壤之 pH 均在5.0以下，冲積之 pH 較高，其中竹南、頭分、新竹之土壤 pH 在6.0以上。

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* 本試驗之經費承中國農村復興委員會資助，試驗中所用之石灰，承臺灣肥料公司贈與，均此誌謝。

1. 步焱昇　張守敬　臺灣酸性土壤栽培水稻之石灰施用量試驗(第一報)
臺灣省農業試驗所　農業研究　一卷二期1950

2. 張守敬　步焱昇　同上(第二報)　　同上　二卷一期1951

各試驗之產量紀錄，均爲收穫當時之生物質重，列於附表一至附表三，而三個表之結果又彙如表四：

表四、石灰對於水稻穀實產量之影響

Table 4: The response of the yield of rice grain to lime.

增產百分率	1950年二期作 2nd Crop of 1950						1950年二期作 2nd Crop of 1950						1951年一期作 1 st Crop of 1951		
	石灰基肥 Lime as base dressing (3 T/ha)			石灰追肥 Lime as top dressing (3 T/ha)			石灰追肥 Lime aa top dressing (2 T/ha)			石灰追肥 Lime as top dressing (3 T/ha)			石灰基肥 Lime as base dressing (3 T/ha)		
	試驗個數 No. of expt.	百分率 % of total	累積百分率 Summ-ation	試驗個數 No. of expt.	百分率 % of total	累積百分率 Summ-ation	試驗個數 No. of expt.	百分率 % of total	累積百分率 Summ-ation	試驗個數 No. of expt.	百分率 % of total	累積百分率 Summ-ation	試驗個數 No. of expt.	百分率 % of total	累積百分率 Summ-ation
>20	8	12.31	12.31	7	10.94	10.94	3	11.11	11.11	3	11.54	11.54	7	14.58	14.58
20—16	6	9.23	21.54	4	6.25	17.19	0	0	11.11	1	3.85	15.39	9	18.75	33.33
15—11	23	35.38	56.92	2	3.13	2032	2	7.41	18.52	4	15.38	30.77	5	10.42	43.75
10—6	14	21.54	78.46	31	48.44	68.76	6	22.22	40.74	2	7.69	38.46	14	29.17	72.92
5—1	12	18.46	96.92	13	20.31	89.07	13	48.15	88.89	13	50.00	88.46	11	22.92	95.84
1—0	2	3.08	100.00	7	10.94	100.01	3	11.11	100.00	3	11.54	100.00	2	4.17	100.01
合計 Total	65	100		64	100		27	100		26	100		48	100	

由上表，1950年二期作及1951年一期作施用石灰3噸公頃作爲基肥，有95%以上的試驗均增加產量，本試驗目的係示範性質，故設計簡單，管理亦較粗放，試驗誤差可能甚大，今姑以增產百分率達10%以上者爲顯著之標的，則1950年二期作試驗中，有 56.92%可增加 10%以上之產量，1951 年一期作諸試驗中，有43.75%可增加10%以上之產量，約各佔全試驗數中之一半。

石灰作爲追肥之效果，顯然較基肥爲低，用石灰3噸公頃者，可以增加產量之試驗數不及90%，其增產率在10以上者，只佔全試驗數中之20—30%。

DEMONSTRATION ON LIMING THE ACID RICE PADDY SOILS FOR THE SECOND CROP OF 1950 AND THE FIRST CROP OF 1951

S. C. Chang K. S. Huang

Summary

More than two hundred field plot experiments in a simple design for demonstration purpose were laid out on the acid soils of the northern part of Taiwan including red soils, yellow earths and acid alluvial soils with their pH ranging from 4.0 to 6.0 in 1950 and 1951. The size of plot is 50 square meters or 100 square meters as the case may be. No discussion on the response of rice to lime in relation to soil properties and the possible result of overliming by continuous application is attempted to be made in this paper. Only the yield of grain in all the experiments were tabled in tables 1 to 4 and briefly discussed in view to the elucidation of the possibility of increasing the yield of rice by lime on the acid soils of Taiwan.

It is shown that in more than 95% of the experiments the yield of rice responses to the application of 3 tons per hectare of lime as base dressing, and in about 50% of the experiments, the increase of yield is as much as above 10%, which is taken arbitrarily as significant.

The application of 3 tons per hectare of lime as top dressing is less effective than as base dressing. Only in 20-30% of the experiments, the increase of yield is above 10%, but in almost 90% of the experiments, the rice also responses to lime.

附 表 (Appendex)

表一、石灰對於水稻穀產量之影響

Table 1: The Response of Rice Grain to Lime. (2nd crop of 1950)

試驗地點 Location	試驗者 Farmer	穀 產 量 Yield of rice grain (kg/ha)			穀產量指數 Index of rice grain yield			重複數 Replication
		無石灰 No. Lime	石灰基肥 Lime as base dressing (3T/ha)	石灰追肥 Lime as top dressing (3T/ha)				
文山區百忍里	范阿福	2,280	2,400	2,340	100	108	103	1
〃	〃	2,460	2,520	2,520	100	102	102	1
〃	劉張集英	3,000	3,120	3,300	100	104	110	1
〃	劉安	3,100	3,300	3,800	100	106	124	1
〃	陳英通	2,520	3,420	3,180	100	136	126	1
〃	〃	2,880	3,240	3,060	100	111	106	1
〃	林朝延	3,150	3,420	3,120	100	109	99	2
汐止鎭樟樹里	陳德堂	1,628	1,845	1,755	100	113	108	1
〃	黃麒麟	1,650	1,879	1,808	100	114	110	1
〃	陳新居	1,635	1,845	1,770	100	113	108	1
〃	王生	1,628	1,890	1,800	100	116	110	1
〃	王水蓮	1,635	1,875	1,785	100	115	109	1
〃	黃大扁	1,725	1,935	1,830	100	112	106	1
〃	陳再萬	1,612	1,838	1,725	100	114	107	1
〃	陳海堂	1,632	1,864	1,778	100	114	109	1
〃	林正	1,598	1,815	1,699	100	114	106	1
〃	施榜	1,609	1,830	1,732	100	114	108	1
八德鄉瑞豐村	呂城玉	2,610	2,700	2,670	100	103	102	2
興仁村	呂理培	2,370	2,460	2,370	100	104	100	2
〃	呂石灰	3,330	3,150	3,195	100	95	96	2
〃	楊啓能	2,494	2,753	2,759	100	110	110	2
中壢鎭五權里	李蓮興	2,370	2,700	2,550	100	114	108	2
〃	李蓮祥	2,070	2,400	2,250	100	116	109	2
〃	梁生火	2,055	2,190	2,145	100	107	104	2
〃	李連珍	2,220	2,670	2,430	100	120	109	2
北勢村	農職校	2,010	2,580	2,160	100	128	107	2
平鎭鄉南勢村	王年蔣	2,175	2,595	2,445	100	119	112	2

平鎮村	蔡日藏	1,890	2,160	2,040	100	114	108	2
楊梅鎮 瑞源里	溫明鑑	3,075	3,325	3,150	100	108	102	2
〃	古廣財	2,925	3,200	3,150	100	109	108	2
〃	鄭何湖	3,870	3,960	3,950	100	102	102	2
〃	古道財	2,975	3,225	3,000	100	108	101	2
梅溪里	葉雲恩	2,050	2,350	2,300	100	115	112	2
〃	陳丁財	1,800	2,000	1,800	100	111	100	2
〃	鍾運榮	1,300	1,400	1,350	100	108	104	2
太平里	邱石恩	2,050	2,675	2,550	100	130	124	2
三湖里	尹國城	2,050	2,575	2,450	100	126	120	2
〃	鄧易謙	2,360	2,650	2,560	100	112	108	2
湖口鄉 和興村	陳能拔	2,425	2,675	—	100	110	—	2
湖口村	陳謙抗	2,300	2,550	2,450	100	119	107	2
新竹市 南區興中里	翁石生	4,950	5,255	5,155	100	106	104	2
東區前溪里	江榮錦	3,725	3,750	4,780	100	101	128	2
北區南雅里	彭隻會	2,495	2,560	2,675	100	103	107	2
東區光田里	解萬祿	4,925	5,100	5,100	100	104	104	2
臺北市 農試所	農管科	2,113	2,187	2,295	100	103	109	2
文山區 百忍里	*劉張集英	3,100	3,200	3,800	100	103	123	1
〃	*劉安	3,300	3,500	4,000	100	106	121	1
〃	*陳英通	3,420	3,600	3,420	100	105	100	1
〃	* 〃	3,460	4,060	4,020	100	117	116	1
大坪林	*林祺山	3,150	3,060	2,500	100	97	80	1
汐止鎮 樟樹里	陳德堂	1,639	1,830	1,744	100	112	106	1
〃	*黃麒麟	1,665	1,864	1,792	100	112	108	1
〃	*陳新居	1,550	1,330	1,755	100	111	109	1
〃	*王生	1,675	1,845	1,785	100	113	109	1
〃	*王水蓮	1,650	1,860	1,755	100	113	106	1
〃	*黃大扁	1,740	1,890	1,819	100	109	105	1
〃	*陳再萬	1,624	1,815	1,695	100	112	104	1
〃	*陳海堂	1,770	1,830	1,755	100	103	99	1
〃	*林正	1,612	1,838	1,680	100	114	104	1
〃	*施榜	1,616	18,19	1,718	100	113	106	1

註：有* 號者爲在來種水稻，無者皆爲蓬萊種水稻。

表二、石灰對於水稻穀產量之作用

Table 2: The Respanse of Rice Grain (Japanese Variety) to Lime. (2nd crop of 1950)

試驗地點 Location	試驗者 Farmer	穀產量 (kg/ha) Yield of rice grain			穀產量指數 Index of rice grain			重複數 Replication
		無石灰 No Lime	石灰追肥 Lime as top dressing (2T/ha)	石灰追肥 Lime as top dressing (3 T/ha)				
臺北新莊	農場	4,000	4,050	4,150	100	101	104	2
〃	〃	3,750	3,800	3,750	100	101	100	2

桃園鎭淸溪里	賴淸忠	2,145	2,603	2,470	100	121	115	2
〃	賴淸額	2.652	2,790	2,779	100	105	105	2
〃	賴淸國	2,292	2,418	2,651	100	105	116	2
〃	蘇水茂	2,700	2,858	2,745	100	106	102	2
八德鄉大湳村	謝澤讓	3,430	3,860	3,580	100	113	104	2
〃	謝阿菓	3,622	3,950	3,740	100	109	103	2
〃	〃	3,630	3,930	3,720	100	108	102	2
〃	謝觀福	4,215	4,330	4,320	100	103	102	2
〃	〃	4,410	4,521	4,530	100	103	103	2
〃	謝樹置	5,280	5,610	5,370	100	106	102	2
大安村	蕭明	3,300	3,600	3,750	100	109	114	2
湖口鄉和興村	陳能拔	2,419	2575	—	100	106	—	2
德盛村	翁林金立	1,900	2,100	2,350	100	111	124	2
〃	彭雲生	1,725	1,775	1,975	100	123	130	2
〃	張大亮	2,125	2,175	2,275	100	102	107	2
〃	翁林阿泉	2,325	2,400	2,475	100	103	106	2
信勢村	陳心訪	1,975	2,025	2,200	100	103	111	2
〃	陳謙裕	2,125	2,175	2,300	100	102	108	2
和興村	曾維眞	2,350	2,425	2,600	100	103	111	2
長嶺村	張霖	1,825	2,250	2,375	100	123	130	2
新竹市東區埔頂里	黃猪	3,075	3,070	3,090	100	100	100	2
〃	呂郭顯	3,370	2,385	3,420	100	100	101	2
〃	張壽	2,708	2,640	3,730	100	97	100	2
〃	黃吉	2,835	2,935	2,890	100	104	102	2
北區士林里	翁琳合	3.720	3.745	3,793	100	101	102	2
寶山區深井里	鄭阿發	2,580	2,675	2,678	100	104	104	2

表三、石灰對於水稻產量之作用

Table 3: The Response of Rice Grain to Lime. (1st crop of 1951)

試驗地點 Location	試驗者 Farmer	穀產量 Yield of riee grain (kg/ha) 無石灰區 No Lime	石灰區 Limed (3T/ha)	穀產量指數 * Index of rice grain	重複數 Replication
臺北汐止鎭樟樹里	陳德堂	4,040	4,410	109	6
〃	黃鷲英	4,400	4,760	108	6
〃	陳海堂	3,000	3,220	107	6
〃	王龜理	3,480	3,800	109	6
〃	王水蓮	4,100	4,480	109	6
〃	黃大扁	4,530	4,860	107	10
桃園蘆竹鄉蘆竹村	林鋃	3,350	4,408	130	6
〃	林元有	2,948	3,668	124	6
〃	林昌	2,960	3,338	113	6
〃	林元華	3,590	3,452	96	6
〃	謝木全	6,130	6,227	102	6

* 以無石灰區穀產量作爲 100 (Grain yield of no lime plot is taken as 100)

桃園桃園鎮東埔里	李錫揚	4,962	5,354	108	6
〃	謝樹生	5,608	5,884	105	6
〃	楊長庚	4,276	4,724	111	6
〃	楊泉	4,226	4,476	106	6
〃	康泉	5,425	6,333	117	6
桃園八德鄉	呂石火	4,030	4,750	118	6
〃	呂坤玉	3,196	3,326	104	6
〃	呂理培	3,450	3,886	113	6
〃	呂家	3,700	4,324	117	6
新竹竹北鄉竹北村	陳富	6,366	7,466	117	6
〃	黃輝	5,424	6,150	113	6
〃	黃四海	4,550	5,582	123	6
〃	魏春木	4,926	5,934	119	6
〃	黃火	9,732	6,832	102	6
〃	黃溪福	5,226	5,626	108	6
〃	陳來居	5,200	5,566	107	6
〃	黃家中	5,012	5,976	119	6
〃	黃興	4,200	5,034	120	6
新竹新埔鎮	魏德盛	4,050	5,124	127	6
〃	魏文嵐	3,462	5,358	155	6
〃	陳阿房	4,100	4,526	110	6
〃	林龍發	4,974	3,832	130	6
〃	林祺德	3,988	4,650	117	6
苗栗竹南鎮大厝里	陳千	4,950	6,258	126	6
〃	陳培元	4,674	4,700	101	6
〃	陳興	6,880	7,412	108	6
〃	陳金東	5,382	5,800	108	6
〃	陳森南	5,466	6,416	117	6
〃	黃坤	5,794	6,586	114	6
〃	劉進村	5,270	5,398	102	6
苗栗頭份鎮蘆竹里	洪石佛	3,560	3,660	103	6
〃	陳龍池	3,218	3,213	100	6
〃	林阿三	3,400	3,467	102	6
〃	陳春良	6,283	6,432	103	6
〃	連添丁	6,178	6,425	104	6
〃	李石頭	7,225	7,462	103	6
〃	陳新發	3,233	3,410	106	6

猪蛔蟲之驅除試驗(第三報)

(附中日美三國生產猪之寄生蟲調査報告)

*陳 耀 錕 **李 永 基

一、 緒 言

在家畜寄生蟲疾病中，具有高度感染率和廣汎流行性者，或可推爲蛔蟲，所以國不分大小，地不分東西，凡是老的幼的家畜，差不多没有一個不曾受過蛔蟲的感染(請參閱第三表)。蛔蟲病之經過歷程由始即屬比較緩慢，絕不像急性傳染病那樣會於瞬息之間，剁奪掉家畜之生命，而立時招致經濟上莫大的損失，故往往易爲一般人所輕忽地看過。究其實蛔蟲病的爲害，時日綿長持久，累計損失，積漸加多，恰如一種長期的消耗戰。茲僅就因猪蛔蟲所引起發育不良、衰弱，直接對其本身效能上、繁殖上、經濟上所蒙受之損失而論，已足驚人，再加以綿續不斷的養份消耗，其實際損失，或將超越急性傳染病以上，亦未可知(請參閱編末照片)。

據筆者等第三表調査所得猪蛔蟲寄生率之結果，可知臺灣及日本產的猪隻約爲68%，美國產的猪隻剛達88%，且有遠過兩國以上之事。由此高度寄生率一點看去，便知蛔蟲對養猪事業的威脅是多麼利害，安可付諸等閒視而不稍加注意焉。再照筆者等前作兩次驅蛔(第一報第二報)試驗看來，認爲使用價廉而驅蟲效力具有100 %之畜蟲散(主要成分爲氟化鈉 Sodium Flouride)，殊有推薦給全省畜猪者使用的價值。然爲顧慮使用此項畜蟲散不至發生副作用而招致無謂損失和推廣上發生某程度障礙起見，試將投藥量從最小完全量內再減去三成加以投與時，究對猪蛔蟲的驅除能有多大效用，藉供檢討，亦即本試驗開始之動機。茲將本試驗所得一部份結果，先在此間提出報告。

自昨年起，本省當局與農村復興委員會，爲謀改進臺灣猪隻品質，以免事業衰退，曾向日本及美國輸入多數種猪，其中一部份撥交本試驗所收養，故即就此等猪隻，施行寄生蟲調査，知各國一樣地均有着相當數的寄生，惜以頭數無多，頗感遺憾，但爲明瞭罹患者狀況，提供各同業先進，藉供研究，冀能拋磚引玉，則筆者認爲不無多少價值。

二、 試驗材料及方法

(A) 試驗材料

(1) 試驗猪隻：

係本所飼育中之雜種仔猪，年齡均爲出生後四個月至五個月者，其體重平均爲20公斤至30公斤左右。

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(2) 試驗藥品：

係中國獸醫藥物廠製造之甲號畜蟲散及乙號畜蟲散(主要成分均爲氟化鈉 Sodium Fluoride)。

(B) 試驗方法

(1) 先檢査各猪糞便中有無蟲卵(塗抹法)，將內有蛔蟲卵之猪分成三組，個別加以飼養，用上列兩種藥品分在兩組實施驅蟲，另外一組作爲不施藥對照組，以爲比較。

(2) 投藥量，係採取最小完全驅蟲量之七成(卽含純氟化鈉量70%)，亦卽仔猪每公斤體重用 0.08×0.7=0.056克。投藥次數爲連續四次投藥。

(3) 投藥方法：(a) 關於甲號畜蟲散，係將平常供飼養用之煮熟甘藷簽用手拱取約半斤，經擱置於竹篩上數分後，使減少水量，再加入上藥，使混合而成練餌狀，給與，俟其全部吃淨後，再飼以其餘應給而未混藥之混合飼料，在此投藥期內均不能再給以其他之水份。(b) 乙號畜蟲散投藥方法係將平常供飼養之飼料中，取出少量之較濃部份，約2—3公斤，與試藥混和飼餵，待其全部食淨後，再給其餘未混藥之全料，但在投藥期中，可以照常給水，並無妨碍爲其優點。

(4) 投藥前以無須絕食或減食爲原則，投藥後亦不必用各種瀉劑。

(5) 投藥後，分兩星期、一個月及兩個月三次檢査糞便，再就其糞便內對蟲卵所起變化或有無，以判定對猪體內蛔蟲會起何種影響。

三、 試 驗 成 績

以中國獸醫藥物廠出品之甲號畜蟲散及乙號畜蟲散，用在患有蛔蟲症之猪八頭，其一回用量爲仔猪體重每公斤給與 0.056gm，經四次連續投與，然後每隔兩週、一個月、兩個月共三次從糞便中檢査其結果如下表(第一表)：

第一表　畜蟲散減量投與時對蛔蟲生體所起之影響　1951, 3, 5.

藥品別	猪別	驅蟲前蛔蟲卵數	驅蟲後之蛔生卵檢查成績			副作用
			第一次(12月後)	第二次(一個月後)	第三次(二個月後)	
甲號畜蟲散	雜種 95 號	卄	土	土	—	無
	〃 112 號	卄	土	—	—	無
	〃 113 號	卄	土	土	—	無
	〃 114 號	卄	土	—	—	無
乙號畜蟲散	雜種 97 號	+	土	土	+	無
	〃 101 號	卄	土	土	卄	無
	〃 105 號	+	土	—	—	無
	〃 107 號	+	土	土	+	無
對照	雜種 94 號	卄	卄	卄	卄	
	〃 99 號	+	+	+	+	
	〃 100 號	卄	卄	卄	卄	

附註：(1) 表中符號：

(卄)乃表示蛔蟲卵多數(+)乃表示蛔蟲卵少數(土)乃表示無卵殼畸形卵(—)乃表示未發現有蛔蟲卵

(2) 副作用乃指投藥後猪之健康食慾通便以及其他反應

(3) 投約量爲最少完全驅蟲量之70%的分量

依第一表加以觀察，可知甲號畜蟲散之效力較乙號畜蟲散爲優。其驅蟲情形，四頭一樣有效，雖未能立刻把蟲驅出體外，但經過了一個月左右，却都自然而然地把蟲體變得衰弱而至全部排出，其間尙有常見到僅具無卵殼之畸形卵陸續排出之事，其中尤以對該蟲體內臟之屬於生殖器部份認有破壞作用一事，更感有很大意義，至於乙號畜蟲散驅蟲情形，則四頭中僅有一頭得告完全驅除，其他三頭在驅蟲後一個月間，同樣地排出無卵殼之畸形卵，但於兩個月後又再恢復原狀。由此觀之，知乙號畜蟲散，如以同分量之藥，究不似甲號畜蟲散那樣見效，已甚顯然，但在減少傳染源之意義上頗有價值。

四、考　　察

(1) 雖將甲號畜蟲散之投藥量減達最小完全驅蟲量之70%，並無何等副作用，其間縱未能立刻促成排蟲現象，但於一個月前後却能自然而然開始排出，結果效力仍達 100 %，若一般農家能照此減量投藥法而實行投與，認爲是一種最安全不過的方法。

(2) 乙號畜蟲散使用法有其簡便處，因其可與水溶性飼料相混用，爲其優點，但其效力不甚顯著，爲其劣點，今後對減毒及製造方面再加研究，以期使養猪業者，在使用上獲得方便，而效力並未減低之好處。

(3) 假設甲與乙兩號畜蟲散，對驅蟲效力不能達到完全驅除之目的，惟於一個月前後，可使蟲卵變成無卵殼之畸形蟲卵，此種現象亦足認爲有減少傳染源之可能。倘猪蛔蟲爲一種含有人畜兩方共通性時，則更有研究之價值，但此種無卵殼卵以及畸形卵，果成爲感染源否，現正從事研究中。

(4) 關於驅蟲後猪之發育，亦卽猪體重之增長情形，因在此次調查中尙乏確實數字可供記載，故於本期報告內暫且從略。但若僅就對照區方面加以比較，知其確有相當好成績。

(5) 筆者於臺北縣大安種畜場，曾以乙號畜蟲散參照本試驗同樣方法，用於姙娠末期猪及哺乳猪各數例，結果並未發生何種副作用，所得成績亦頗圓滿，由此觀之，乙號畜蟲散，用於姙娠猪或哺乳猪較爲合適，而甲號畜蟲散則務必避免使用。

五、　附中日美三國所產猪寄生蟲調查表

(1) 當茲次作自美輸入種猪之寄生蟲調查時，原想特別單獨着重於猪之蛔蟲一項，惟以蟲卵之成熟期，除猪蛔蟲外，均比較爲短，爲欲使本調查保存眞實性起見，故將其他兩類一概列入，但這些寄生蟲是否於在船時抑爲來臺後所感染者，一時頗難遽下判斷，唯如猪蛔蟲者自感染以至於成熟，所需之日數，最短者須兩個半月以上。査此次由美輸入之猪爲三月初到達基隆，三月六日卽移入農業試驗所，八日卽開始調査，大概從美國出發而至今次調査止，計期總不會超過二個月，故於本表所顯現蛔蟲數字，確信係於美國本土內已受感染，殆屬無疑。至於猪腎蟲自感染而至成熟，爲期約需六個月，而輸入之猪中大多數雖近此年齡，惟據蟲卵檢査上所得之結果，尙未發現有何顯著數目可資參考，故此項調査只可暫時中止。茲將調査結果示如第二表：

第二表　美國輸入種猪之寄生蟲調查成績　1951—3

猪種與號碼	性別	年齡	榮養	體重(kg)	罹患寄生蟲				罹患率
					蛔蟲	球蟲	鞭蟲	鉤蟲	
B 119 號	♀	1/3 歲	良	52.3	卄	+	+		
B 125 號	♀	1/3 歲	良	41.2	+	+			
B 133 號	♂	1/3 歲	良	48.2	+				
B 136 號	♀	1/3 歲	良	45.9	+				
B 140 號	♀	1/3 歲	良	38.2	卄				
B 152 號	♂	1/3 歲	良	50.1	卄				
B 166 號	♂	1/4 歲	普通	28.7	+	+			
B 169 號	♂	1/4 歲	普通	25.7	+	+			
B 190 號	♂	1/2 歲	普通	72.3	卄				
B 220 號	♂	1/3 歲	普通	38.2	卄	卄			
B 223 號	♀	1/3 歲	普通	35.7	卄		+		
B 257 號	♀	1/3 歲	良	37.7					
B 264 號	♀	1/3 歲	普通	37.9	+				
B 271 號	♀	1/3 歲	普通	41.3	+	+	+	+	
B 289 號	♀	1/3 歲	良	46.2		+	+		
B 385 號	♀	1/3 歲	良	50.7	卄				
B 393 號	♂	1/3 歲	良	58.7	+	+			
統計	17 頭	♂ 7 頭			15 頭	8 頭	4 頭	1 頭	16 頭
		♀ 10 頭			88 %	47 %	24 %	6 %	94 %

若據第二表看來，關於猪蛔蟲以外之寄生蟲，姑且不論，但就其全般性言，大可窺察出其寄生種類不多，則為事實，當時雖因受制於經費等關係，致欲調查之例數不能做到所輸入種猪之全部(指農復會由美輸入種猪之全部)，惟在此少數例調查裡，總未嘗發現過有一頭猪曾經寄生上什麼種都有之寄生蟲，這也許算是筆者等許多調查例子中，所未嘗經驗過之一例，故認為頗有注意之價值，但若在猪蛔蟲寄生率達88%之高度率一端看來，可知卽在美國本土，這個猪蛔蟲，亦為養猪業者一大威脅，總可無疑。

(2) 中、日、美、三國所產猪隻之寄生蟲調查結果如第三表：

第三表　中日美三國所生產猪隻之寄生蟲調查成績表　1950—1951

調查者氏名	被調查猪產地	調查頭數	罹患寄生蟲 %								寄生蟲	
			蛔蟲	球蟲	桿蟲	肺蟲	鞭蟲	結節蟲	猪胃蟲	Balantidium Coli	頭數	百分比
陳耀錕李永基	省農業試驗所	31	68%	84%	84%	0%	0%	35%	52%	7%	31	100%
陳耀錕李永基	日本輸入種猪(農試)	18	68%	100%	39%	0%	5%	22%	%	68%	18	100%
蘇振杰李永基	西部種畜場	72	68%	96%	0%	29%	24%	0%	%	13%	72	100%
陳耀錕李永基	美國輸入種猪(農試)	17	88%	47%	0%	0%	24%	0%	%	0%	16	94%

綜觀第三表知臺灣及日本輸入之種猪，其蛔蟲罹患率均在68%，而美國輸入者反遠超此數字，曾達88%高寄生率，實堪注意，大抵蛔蟲球蟲（Coccidium）兩種各國均甚普遍，因其本身係一同性質

之寄生蟲，不若其他寄生蟲，每因環境集團猪舍等關係而有某種寄生蟲特多，而某種寄生蟲特少等之事。至猪腎蟲在各國本亦甚多，玆次因經費時間以及猪本身年齡等關係，未克實施，故在表中附以不明之(？)符號以資識別。又表內所示之球蟲，桿蟲， Balantidium Coli 等數字，固難斷定爲在該國所感染者，因該蟲等發育所要之日數較短，兩地均有可能，特此註明，藉保誠實。

六、 結 論

(1) 甲號畜蟲散驅蟲效力優於乙號畜蟲散，就其用量上言，可以最小完全量，亦卽有效驅蟲量之七成，混入練餌中，經連續四次投藥後，仍具 100％之驅蟲效力，且無絲毫之副作用。以實例言之，卽成猪(指50公斤以上者)體重每公斤用 0.35gm 純氟化鈉含量，仔猪(50公斤以下者)每公斤用 0.056gm 純氟化鈉。

(2) 若以乙號畜蟲散照甲號畜蟲散同分量投與時，則其效力不及甲號畜蟲散，其有效驅蟲率只有25％，但於投藥後對蟲體之影響，爲一個月內所排出之蟲卵爲無卵殼之畸形蟲卵，此種事實，與感染源遮斷可能性上很有研究之意義。

(3) 按兩者效力比較試驗結果觀之，在現在情形下，一般養猪業者，自以希望採用甲號畜蟲散爲宜，乙號畜蟲散雖具有可與水溶性飼料混用之特點，惟以效力較差，尙待研究，另提報告以供參考。

(4) 在中日美三國所產各各猪隻寄生蟲調查時，惜以例數不多至感遺憾，然於大體上觀之，猪蛔蟲之寄生率，仍總在60％至90％之間，可見蛔蟲病對各國養猪業者之威脅性。故於養猪業之利益言，對使用有其簡便之乙號畜蟲散，實有再加改善，以應需求之必要。

臨終本試驗頗承畜產系猪場各位先生及中國獸醫藥物廠廠主張木全先生惠予協力，深致謝個。

七、 參 考 文 獻

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STUDIES ON THE MEDICAL TREATMENT OF THE ROUNDWORM IN PIG.

(Report of investigation of pig parasite in China, America, and Japan is attached)

by

Y. K. Chen, Y. C. Lee.

This test is to continue the preceeding two tests concerning the ronndworms expelling effect of these two Anti-Pigworm-Powders when the dose is deducted 30% from the effective minimum dose.

(1) Sample

The pigs are of 20 to 30 kgs. weight, crossbreed, 4 or 5 months

(2) Drug

The No. 1 and No. 2 Anti-Pigworm-Powder manufactured by the China Veterinary Pharmacist.

(3) Method of procedure

First, we examine the excretions of pigs by the Method of Rubbing. Then divide the infected pigs into three groups and feed separately. Administer successively four times with No. 1 and No. 2 powders individually of dose 70% of sodium fluoride. For instance, it is $0.08 \times 0.07 = 0.056$ gms. per kg. of its own weight for young pigs. While the other group is fed as usual.

(a) Administration of No. 1 Powder

Put a handful of dried sweet potato, after cooking about half pound weight, in a bamboo sieve to reduce the water elements. After a few minutes, mix with a certain dose of drugs and feed the pigs. After that, the remainder, the original feed, be continuously fed. During test, no water is allowed,

(b) Administration of No. 2 Powder

Take a small portion from the feed about 2 or 3 kgs. mix it with a certain dose of drugs for feed. Then furnish the remainder. The difference from the No. 1 is that water for feed is allowed. It requires neither without feed or decrease feed before administration nor purgative after administration.

(4) Examination of excretions

This exmination is being made in the period of two weeks, one month, and two months after the administration. From the transformation of the parasitic eggs in the excretions, the affect to the parasite inside the body will certainly be testified

(5) Summary

(a) When the dose is deducted by 30%, for No. 1 Powder, the effect is sufficient and no extra reaction.

(b) The worm expelling effect of No. 1 Powder then that of No. 2. But the latter is more convenient for administration.

(c) One month after the administration of No. 2 Powder, the Pigs expel shellless deformed eggs from the inside of the body.

(d) From the investigation reports of pig parasites, the roundworm almost lies therein between the rate of 60 to 90 percent.

砂糖還原鉻鹽鞣液初步試驗

鄭謀平　駱承庠　李欽淵

一、緒　言

鞣製劑大別之可分爲植物性與礦物性；植物性鞣劑其主要者首推單寧，礦物性鞣劑其主要者則爲鉻鹽，此兩種鞣劑各有其特性，例如用單寧鞣成之革，耐水性强而耐熱性弱，由鉻鹽鞣成之革適與此相反，卽耐熱性强而耐水性弱，其性質全然不同。又在鞣製時間上言，鉻鞣迅速，單寧鞣則緩慢，需時較長，頗不經濟，是以近年以來除製造底革及特殊革之外，有被鉻鹽鞣法壓倒之傾向。

考鉻鹽鞣法之發見，始自1858年 F. L. Knap 氏，其後經許多硏究者之不斷努力，至1884年 Augustus Schuly 氏首創鉻鹽二浴鞣製法 (Two bath process), 1893年 Martin Dennis 氏完成鉻鹽一浴鞣製法 (One bath process)，至1897年 H. R. proctor 氏發表一浴鉻鹽鞣製可製自重鉻酸鉀 (Potassium bichromate) 葡萄糖 (Glucose) 及鹽酸，卽爲今日最普通使用之一浴鉻鹽鞣製劑。

鉻鹽鞣製法有一浴 (One-bath chrome tannage) 與二浴 (Two-bath chrome tannage) 兩種，已如前述；但二浴法因操作複雜，技術上調節困難且不經濟，故近四五十年以來，因一浴法在技術上經濟上以及製品之品質上，均能適應時代之要求，一躍而佔鞣製法之王座矣。

鉻鹽爲强酸性物，調製時必須加以還原劑使鉻酸還原，將六價之鉻(Cr^{++++++})變成三價之鉻(Cr^{+++})，三價鹽基性鉻之化合物 $Cr(OH)SO_4$ 始具有鞣皮效用；其還原劑，普通多用次亞硫酸鈉 ($Na_2S_2O_3$) 或葡萄糖，唯此等原料多屬舶來品，價格昂貴，每年漏巵又大，設一旦輸入杜絕，鞣製卽有停頓之虞，作者有鑒及此，擬以本省所產之砂糖，代替舶來品之次亞硫酸鈉 (Sodium thiosulphate) 及葡萄糖而行試驗。

本試驗分三步進行：(一)砂糖還原適量試驗；(二)各種鹽基度鞣製比較試驗(砂糖還原液)；(三)理化分析。

二、試驗材料

本試驗所用之砂糖爲臺灣糖業公司出品之一級白砂，其成分爲：

糖分	水分	灰分	還原糖
99.46	0.054	0.243	0.128

三、試驗方法

(一)砂糖還原適量試驗：

A. 砂糖用量：用砂糖還原時，其性質亦與葡萄糖等相似，用量少則還原不能完全，過多則不僅浪費砂糖，且能影響鞣製效用，故用量必須探求適當。茲將處理情形列表如後：

表一　砂糖用量試驗表

Table 1. An Experiment on the using Quantity of Cane Sugar

試驗號數 Series No.	$K_2Cr_2O_7$ 用量 (g) Amount of $K_2Cr_2O_7$(g)	硫酸用量(95%) (cc.) Amount of H_2SO_4 (95%) (cc.)	添加水量 (cc.) Added water (cc.)	砂糖 (%) Amount of cane sugar (%)	用量 (gm.) (gm.)	備註 Remark
1	15.000	7.9	100	36.0	5.40	
2	15.000	7.9	100	37.0	5.55	
3	15.000	7.9	100	38.0	5.70	
4	15.000	7.9	100	39.0	5.85	
5	15.000	7.9	100	40.0	6.00	
6	15.000	7.9	100	41.0	6.15	
7	15.000	7.9	100	42.0	6.30	
8	15.000	7.9	100	43.0	6.45	

〔註〕：1. 還原時先將砂糖用 20cc. 熱水溶解後再徐徐加入。
2. 還原完了後各稀釋成 250cc. 以供分析之用。

B. 砂糖還原液之組成：根據第一表，以不同量之砂糖還原之後，其還原液之組成自有不同。茲將其各組還原液之組成分析如下表：

表二　砂糖還原鉻鹽鞣液之組成

Table 2. The Composition of using Cane Sugar for reducing Chrome Tanning Solution

試驗號數 Series No.	Cr_2O_3 含量 (%) The percentage of Cr_2O_3	SO_3 含量 (%) The percentage of SO_3	未還原之 Cr_2O_3 (%) The percentage of unreduced Cr_2O_3	$Ba=\frac{Cr_2O_3}{SO_3}\times 100$	備註 Remark
1	3.9125	3.4781	0.2428	112.49	
2	3.9974	3.8965	0.08096	102.59	
3	3.9968	3.9056	0.08072	102.33	
4	3.9974	3.9831	0.03050	100.36	
5	4.0990	4.0208	—	101.94	
6	4.0480	4.0994	—	98.74	
7	4.0480	4.0967	—	99.46	
8	4.0480	3.9654	—	102.08	

由上表觀之，用砂糖還原鉻鹽鞣液時，以第五號最爲適宜(即砂糖用量爲鉻鹽用量之40%)。根據分析結果，不僅未還原 Cr_2O_3 已全無存在，且 Cr_2O_3 之含量亦冠於其他各組，由此可知砂糖之添加過多時毫無裨益，過少則未能全部還原，故最適合者當爲第五組。

(二)各種鹽基度(砂糖還原之鉻鹽液)鞣製比較試驗：

根據第三表所述，砂糖還原鉻鹽鞣液時，砂糖之用量以鉻鹽量之40%最爲適宜，唯其鹽基度是否適合於實地鞣製，仍難以決定；故再將是項鞣液，或加氫氧化鈉，或加硫酸，分成七種不同之鹽基度與實地鞣製，而觀察其結果。

A. 砂糖還原鉻鹽原液之調製：　　表三

$K_2Cr_2O_7$	200gm.
H_2SO_4(95%)	108.69c.c.
Cane Sugar(40%)	80gm.
Water	800c.c.

還原完了後，稀釋成 1000c.c. 以供試驗，根據分析結果其組成爲：

Cr_2O_3 (g.)	SO_3 (g.)	未還原 Cr_2O_3	$Ba=\frac{Cr_2O_3}{SO_3}\times 100$	備　　註
10.2212	11.1309	—	91.8272	

B. 鞣製用鉻鹽鞣液之調整：

將上列原液分成七組(每組 70 c.c.)用酸或鹼調整後，以供實地鞣製。玆將鞣液之調整情形列表如後：

表四　鞣製用鉻鹽液調整表

Table 4. The Preparation of Chrome Solution for Tanning

試驗號數	原液添加量	N/2 硫酸添加量	N/2 NaOH 添加量	水添加量	總稀釋容量
Series No.	The amount of tanning solution reduced by cane sugar (cc.)	Amount of added N/2 H_2SO_4 (cc.)	Amount of added N/2NaOH (cc.)	Amount of water (cc.)	Total volume (cc.)
I	70.0	65.00	0	365.0	500
II	70.0	32.50	0	397.5	500
III	70.0	0	0	430.0	500
IIII	70.0	0	48.0	382.0	500
V	70.0	0	96.0	334.0	500
VI	70.0	0	144.0	286.0	500
VII	70.0	10	192.0	228.0	500

上述調整後之鉻鹽鞣液在未開始鞣製之前，其組成分析如下：

表五　鞣製開始前鉻鹽鞣液之組成

Table 5. The Composition of Chrome Solution before Tanning

試驗號數 Series No.	Cr_2O_3 %	SO_3 %	$Ba=\frac{Cr_2O_3}{SO_3}\times 100$
I	1.4269	2.0870	68.37
II	1.4269	1.8922	75.41
III	1.4269	1.6696	85.46
IIII	1.4269	1.4748	96.75
V	1.4269	1.3079	109.09
VI	1.4269	1.1409	125.07
VII	1.3966	1.0574	132.08

C.　鞣製試驗：

本試驗所用之生皮，係經脫灰後之大黃牛皮，沿其背線裁取濶 15cm 之兩條，在下列浸酸液中處理40分鐘。

浸酸液：HCl　　1%

NaCl　　7%

H_2O　　200%

浸酸後用吸水紙吸去水分，然後切成長13cm. 寬10cm. 厚約2cm. 之皮片，其重量均為 20gm.（水分含量約65%），用第四表配成之溶液，各取 200cc.，另加 NaCl 10gm.，裝入廣口瓶中，置動盪機內，連續振盪鞣製48小時，然後取出水洗，除留小部分作煮沸試驗外，餘均掛乾以供分析之用。茲將鞣製完成後鞣液中 Cr_2O_3 及 SO_3 之變化情形分析如後：

表六　鞣製殘液中之變化

Table 6. The Composition of Chrome Solution after Tanning

試驗號數	Cr_2O_3 含量 %	SO_3 含量 %	$Ba=\frac{Cr_2O_3}{SO_3}\times 100$
Series No.	The percentage of Cr_2O_3	The percentage of SO_3	$Ba=\frac{Cr_2O_3}{SO_3}\times 100$
I	1.3561	1.8088	74.94
II	1.3561	1.6694	81.23
III	1.2751	1.5583	81.83
IIII	1.2549	1.4053	89.30
V	1.2144	1.2244	99.18
VI	1.1537	1.0296	112.05
VII	1.0221	0.9183	111.30

D.　煮沸試驗：為明瞭鞣製程度如何，最簡便之方法為煮沸試驗，茲將上列試驗之耐熱度列表如後：

表七　鞣製48小時後之耐熱度

Table 7. The Boiling Test after Tanning for 48 hrs.

試驗號數	Series No.	I	II	III	IIII	V	VI	VII
耐熱度	Boiling test	71°C	71.5°C	80°C	86.5°C	96.5°C	94.5°C	93°C

E. 化學分析：茲將分析結果列表如後：

表八　成革化學組成

Table 8. The Chemical Composition of Manufactured Leather

試驗號數	Series No.	I	II	III	IIII	V	VI	VII
水分 %	Water	26.0137	26.3049	24.8163	25.9864	27.6388	26.8460	29.7964
灰分 %	Ash	4.0465	4.1271	4.5378	4.9567	5.9537	7.1861	7.9395
蛋白質 %	Protein	41.3967	40.8250	41.7181	40.6618	39.2835	38.1811	36.4813
Cr_2O_3 %	Cr_2O_3	0.7031	0.7043	1.5183	1.7201	2.4259	2.5326	3.1608

F. 物理試驗：因缺乏儀器設備，無法着手，尙待繼續試驗。

四、結論

1. 用砂糖還原鉻鹽鞣液時，砂糖之用量以鉻鹽用量之40%爲最適宜。
2. 利用砂糖還原之鉻鹽鞣皮時，其鹽基度以109度最爲適宜。

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A PRIMARY STUDY ON USING CANE SUGAR FOR REDUCING CHROME SALTS TANNING SOLUTION

by

M. P. Chen; C. S. Loh; K. Y. Lee.

Summary

Chrome salts, when it is used for tanning leather, must first reduced to basic chrome salts by glucose or sodium thiosulphate, otherwise there would be no true tanning value at all. But these reducing agents, glucose and sodium thiosulphate, are all being imported from abroad, not only the price of which is too high, but also it can hardly be bought in Taiwan. The object of this experiment is to study whether there is any possibility to use cane sugar which is now one of the main agricultural products in Taiwan, as a substitute for glucose and sodium thiosulphate. The result is summarized as follows:

1. When using cane sugar for reducing chrome salts tanning solution, the proper quantity of cane sugar is 40% of chrome salts.

2. When using cane sugar for reducing chrome salts tanning solution the best results are obtained when the basicity of the solution is 109.

咖啡幼苗期遮蔭試驗

張　振　宙

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一、引　言　　四、結　果
二、目　的　　五、結　論
三、材料及方法

一、引　言

咖啡（Coffee）爲世稱三大飲料之一，熱帶各地栽培甚廣，其品種頗多，可概括爲阿刺比亞（Coffea arabica, L.）、利比利亞（Coffea liberica Hiern.）及羅布斯他（Coffea robusta, Linden.）三大系（types），普通所稱咖啡，概指阿刺比亞咖啡而言，阿拉比亞咖啡原產亞比西尼亞（Abyssinia），分佈於該地山谷地帶，就其生態觀之，知其必具耐蔭性（tolerance）。十五世紀時，在阿比西尼亞開始人工栽培，栽培地位多選在高山之麓，並曾用一種白楊樹（Populus）植供蔽蔭，生長均佳。嗣經引種錫蘭、印度、爪哇及南美等地，初不諳其生長習性，無不失敗。乃就選地及栽培方法予以注意，知栽培於高山者其生長旺盛，所產咖啡品質優良；在平地栽培者，雖不如高山之理想，但如土質肥沃，排水良好，蔽蔭適當，生長亦可望良好。

咖啡生長適於溫暖氣候，其適於栽培之區域，爲北至北緯 28°，南至南緯 38°，因性忌霜，氣溫以年平均 70°F，而最低平均溫度不低於 55°F，最高平均溫度近於 80°F 者爲最適宜。垂直分佈在熱帶於海拔6000呎以下均可生長，liberica 及robusta 兩種，較適於海拔3000呎以下之山地，對於環境之適應，及病蟲害之抵抗較强，不予遮蔭，生長亦可良好。arabica 則以生長於較高海拔者，所產咖啡之品質爲最優良，喜豐沛而分佈均匀之雨量（年雨量不得少於 50 吋），長期之乾燥對其生長影響甚大，臺灣臺中以南之氣溫及雨量，與咖啡所適應者甚爲接近，臺中年平均溫度爲 71°F，最高平均溫度爲 81.5°F，最低平均溫度爲 64.9°F，年雨量爲 62.7吋；臺南年平均溫度爲 73.6°F，最高平均溫度爲 83.7°F，最低平均溫度爲 66.4°F，年雨量爲62.9吋；恒春年平均溫度爲 75.9°F，最高平均溫度爲 82.5°F，最低平均溫度爲 70.9°F，年雨量爲 79.5吋；臺東年平均溫度爲 74.1°F，最高平均溫度爲 81.7°F，最低平均溫度爲 64°F，年雨量爲65吋；花蓮年平均溫度爲 72.3°F，最高平均溫度爲 79.7°F，最低平均溫度爲 66.6°F，年雨量爲 68.9 吋；均能適合咖啡之需要。故在臺灣栽培咖啡，不失爲一理想環境。自日

人明治三十五年引種結果，認爲咖啡在臺灣極爲適合，嗣經推廣至臺中、花蓮、臺東等地栽培者，生長均莫不良好，且所產咖啡品質及產量，並不亞於其他熱帶各地所栽培者；故當時日人對於咖啡事業之發展，頗爲注意。後因大戰發生，百業凋蔽，咖啡事業遂亦因此一蹶不振，惟臺灣既爲栽培咖啡之一良好環境，爲供給本省需要，進而發展爲外銷之貿易，增益臺灣之經濟基礎計，斯業似仍有重振之價值。作者不敏，玆特着重於實用，就咖啡栽培之方法方面，作一幼苗期之遮蔭試驗，探求遮蔭對於幼苗生長之關係，爲撫育苗木應加注意事項之一參考。

二、目　　　的

阿剌比亞咖啡 (Coffea arabica, L.) 性忌强光，尤以幼苗期爲甚，在幼苗期無遮蔭設備者，葉色蒼黄，纖弱多病，生長極慢，予以遮蔭，則可增進其生長。惟一般苗圃方面所用之蔭棚，其透光情形以何等程度爲最適合，則無說明。本試驗之目的，爲在不同之透光度之竹簾下，測定其生長，以明瞭咖啡之需光量，庶設置蔭棚時，對於應予蔭蔽之程度有一考慮之標準。

三、材料及方法

(1) 蔭簾之設置：用不同寬度之竹片，以蔴線編織成簾，遮蓋苗床，竹片之寬度分 0.5cm. 1.0cm 1.5cm. 三種，長度爲四尺五寸，其透光度經分別測定，各爲46.45%、34.93%、25.28%；設置蔭簾之高度爲2尺。

(2) 試區規劃：試區採用4×4拉丁方排列，小區面積爲4尺×8尺，咖啡種植之株行距爲6寸×6寸，每行種植6株，每列14株，每小區爲84株，各處理代號所代表之透光度爲：

A=100%；　B=46.45%；　C=34.93%；　D=25.28%

(3) 苗木：本試驗所用苗木爲移植之實生苗，於民國三十八年十一月十五日在溫室播種，卅九年一月中旬開始發芽，五月九日移植於試區，苗木經過選擇，生長正常，根系完整而無病蟲害者，移植時各小區之苗高經分別測定。

(4) 苗木乾燥：苗木莖葉之乾重量，係用本分所果品加工用之木製乾燥箱，以木炭火烘乾而求得者，乾重固定時之溫度爲115°C。

四、結　　　果

本試驗於三十九年十月二十一日告結束，歷時五閱月又十一日。玆將其結果記述如下：

(1) 遮蔭與苗木高生長之關係：本試驗各小區苗木移植時之高度，事前經分別測定，試驗結束時各小區均有缺株，玆爲明瞭各處理移植時之苗木總高是否差異顯著及各處理於試驗結束時之總高生長是否受缺株之影響，經分別作苗木始高(缺株除外)之變量分析及株數與總高生長之相關變量分析，結果在始高變量分析中機誤變量除處理變量之 F 值爲1.688, 但查 Snedecor氏F 表之顯著標準值(F值)爲4.76，大於以上之 F 值，知移植時各處理間苗木之始高無顯著差異，故玆後各處理間苗木總高生長之差異應歸諸蔭簾之效應。始高之影響可能甚微，又在株數與總高生長之相關變量分析中，機誤廻歸顯著性測驗之 F 值爲2.066，查 Snedecor 氏F 表其 5 %之顯著標準值 (F 值) 爲6.61，大於機誤廻歸之

F 值，知苗木總高生長受缺株之影響，亦無顯著之差異，故在結果之分析方面，苗木之總高生長可不必用株數矯正之。茲僅示遮蔭與苗木總高生長之變量分析（第 1 表）如下：

第一表　苗木總高生長之變量分析

(Analysis of Variances of the Height Growth of Seedlings)

變異原因 Causes of Vaitaion	自由度 Degrees of Freedom	平方和 Sums of Squares	平均方和 Variances	F
橫行 Rows	3	31.19	10.397	
直行 Colums	3	27.02	9.007	
處理 Treatments	3	426.86	142.287	31.867**
機誤 Error	6	26.79	4.465	
總數 Total	15	511.86		

上表 F 值遠大於同自由度1%之顯著標準值（6.99），知各處理間之苗木總高生長量其差異極爲顯著，茲占以 t 測驗以比較各處理間之差異情形(第2表)如下：

差異之標準差 $SEd=\sqrt{4.465\times4\times2}=5.977$

差異顯著所需之差數 $(P=0.05)=SEd\times t=5.977\times2.447=14.626$

差異顯著所需之差數 $(P=0.01)=SEd\times t=5.977\times3.707=22.157$

第二表　苗木總高生長量比較表 (Comparisons of the Height Growth of Seedlings Based on the Plot Area in Different Treatments.)

處理 Treatments	高生長量 (m.) The Height Growth of Seedlings	D	C	B
D	120.18			
C	103.34	16.84*		
B	103.29	16.89*	0.05	
A	63.95	56.23**	39.39**	39.34**

根據上表之比較，除 C. B 兩處理間之苗木總高生長量無顯著之差異外，其他各處理間之差異均顯著，尤以 A 與 D. C. B 間之差異爲最，知咖啡幼苗之高生長與遮蔭之關係甚大，遮蔭愈甚對其高生長愈爲有利，就對高生長而論，因 D 與 C. B 兩處理間之差異均顯著，故知蔭簾之透光度爲 25.28% 者，其效應爲最大，透光度爲 34.73% 及 46.45% 者，雖較不遮蔭者極爲有利，但二者之間無顯者之差異，故在實用方面，採用任何一種均具同樣之效果。但苗木之高生長迅速者，其組織並非卽屬健全，在過分蔭蔽與相當濕潤之情形下，往往引起苗木之徒長，其組織脆弱而水分之含量特高，健全之苗木共組織必甚密緻而堅韌，含水量不致過高，故表示苗木之實際生長，一般概以苗木之乾重量爲根據，乾重量愈高者，認爲其生長亦愈健全，本試驗經求得苗木莖葉兩者之爐乾重量，藉作苗木實際生長之比較。茲分述如後：

(2) 遮蔭與苗木葉量(爐乾重量)生長之關係：株數與葉量之相關變量分析中之機誤迴歸顯著性測

驗之 F 值爲0.001.，小於同自由度 5%之顯著標準值 (6.61)，故在結果之分析方面，本試驗各處理間之葉量 (單位g.) 亦可不予矯正。茲示其變量分析(第3表)如下：

第三表　苗木葉量生長之變量分析
(Analysis of Variances of Leaf Increments in Dry Weight)

變異致因 Causes of Variation	自由度 Degrees of Freedom	平方和 Sums of Squares	平均方和 Variances	F
行 Rows	3	1295.82		
直行 Columes	3	2187.26		
處理 Treatments	3	23776.17	7125.39	2.769
機誤 Error	6	17174.19	2852.35	
總數 Total	15	44433.41		

以上 F 值不顯著(查 Snedecor 氏 F 表，$n_1=3$；$n_2=6$；$P=0.05$；$F=4.76$，知各處理間之葉量無顯著之差異，惟 t 測驗中，當機誤自由度爲6時，所需之顯著差數爲 $SEd \times t = \sqrt{2862.36 \times 4 \times 2}$ 2.447=370.23(5%標準)

或 $SEd \times t = \sqrt{2862.36 \times 4 \times 2} \times 3.707 = 560.87$ (1%標準)而 B. C. D 三處理之葉量與 A處理比較時，其差數各爲：

B—A=662.3—260.0=402.3

C—A=651.9—260.0=391.9

D—A=784.9—260.0=524.9

以上差數均大於 5%之顯著標準值，故 B. C. D 等處理對於 A 處理間之葉量差異實際或仍有顯著之可能，故吾人或仍可認爲設置蔭簾對於咖啡幼苗之葉量生長甚爲有利。有蔭簾處理間之效應之不顯著或係由於此等透光度均在咖啡適應之界限範圍之內所致。

(3) 遮蔭與苗木莖重生長之關係：株數與莖重 (單位 g) 之相關變量機誤廻歸顯著性測驗之 F 值爲1.24不顯著。知各處理間之莖重亦可不予矯正，茲示其變量分析之結果(第4表)如下：

第四表　莖重生長量之變量分析
(Analysis of Variances of the Stem Increments in Dry Weight)

變異致因 Causes of Variation	自由度 Degrees of Freedom	平方和 Sums of Squares	平均方和 Variances	F
橫行 Rows	3	2266.69		
直行 Columes	3	3164.95		
處理 Treatments	3	13105.00	4368.33	21.073**
機誤 Error	6	1243.76	207.29	
總數 Total	15	19780.40		

以上 F 值大於同自由度之顯著標準值 (9.78)，知各處理間苗木莖重生長量之差異極爲顯著。茲

占以 t 測驗以示各處理間莖重差異之比較（第 5 表)如下：

差異之標準差 $SEd=\sqrt{207.29\times4\times2}=40.72$

差異顯著所需之差數$=SEd\times t=40.72\times2.447=99.64$(5%標準)。

差異顯著所需之差數$=SEd\times t=40.72\times3.707=150.95$(1%標準)。

第五表 各處理間苗木莖重生長量比較表 (Comparisons of Stem Increments in Dry Weight Based on the Plot Area in Different Treatments.)

處理 Treatments	莖乾重 (g) Stem increments in dry weight	D	B	C
D	547.00			
B	489.80	57.20		
C	481.40	65.60	8.40	
A	248.2	298.8**	241.6**	233.2**

由上表，知有蔭簾處理間之莖重生長量均無顯著差異，可證明在透光度 25.28%至 46.45%之範圍內，咖啡之生長均甚適應，與無蔭簾之莖重生長量比較，其差異則極爲顯著，故欲求咖啡幼苗得遂旺盛之生長，設置庇蔭，使其透光量居於25.28%至46.45%之間，應屬必要之措施。

五、結　　論

1. 阿剌比亞咖啡 (Coffea arabica L.) 性忌强光，其幼苗在無遮蔭之情形下者葉片細小，色呈蒼黄，病害亦較嚴重，莖纖細而高，生長極慢，以之與遮蔭之苗木比較，其高度、莖重及葉重等項生長，均呈極顯著之差異，是咖啡之幼苗必需遮蔭，方克生長良好，似無疑問。

2. 在透光度爲 34.93%及 46.45%之蔭簾下之苗木，其高度、莖重及葉重等項生長，均甚近似，但光量減少至25.28%時之高生長與前二者比較，其差異則顯著，其他莖重增加 D 與 B 處理比較爲11.68%，D 與 C 處理比較爲13.63%，葉重增加 D 與 B 處理比較爲15.62%；D 與 C 處理比較爲 16.94%，雖未達顯著標準，但均表示有增加之趨勢，可知在34.93% 及 25.28%之透光度範圍內，光量之增減對於咖啡幼苗生長之影響頗大，尤以高生長爲最明顯，此處高生長之差異能達顯著標準，而莖葉之重並未相應表示顯著之差異，則此種高生長之激劇增加是否即屬徒長之現象，有待繼續觀測之必要，作者不敢遽加論斷，因本試驗經過之時間不過五閱月又十一日，爲時甚暫，且結束時間在十月中旬，並未渡過整個乾季，故茲後在乾季之生長情形爲如何，不得而知。

A PRELIMINARY STUDY ON SHADING IN RELATION TO THE SEEDLING GROWTH OF COFFEA ARABICA, LINN.

By

C. C. Chang

Summary

1. The Arabia coffee (Coffea arabica 1.) usually adapt itself to the environment in partial shading. In the open land, the strong sunlight may retard its growth and make its leaves becoming yellowish and small, and susceptible to disease, particularly in the seedling period. When the coffee is planted under some moderate shading, it will grow vigorously without heavy disease. In this experiment, it showed that the growth of the stem-height, the stem dry weight, and the leaf dry weight of the seedlings were more favorable under the shading of bamboo flames than those without shading.

2. The growth of the seedlings under the flames with 34.93% passage of the daylight showed no prominent difference, when compared with 40.45% passage. But when the light passage through the flames decreased to 25.28%, the differences of height growth of stems between them then became very significant the dry weight growth of stems increased 11.68% and 13.63%, and of leaves increased 15,62% and16.94% more than those with 34.93% and 46.45% light passage respetively. According to the results, it was found that the light passage between 25.28% and 34.93% through the bamboo flames played an important role to the seedling growth of one-year-old coffee plant, particularly to the growth of height.

AN INVESTIGATION ON THE DIETARY CONDITIONS OF TWO RURAL COMMUNITIES IN TAIWAN PROVINCE

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Introduction

For the purpose of obtaining a preliminary information concerning the dietary status of Formosan rural communities, which is a fundamental work for the improvement of their nutrition and health, the writer has made a special investigation on the food consumption in two selected rural communities in the province. Previously, some dietary studies of Formosan inhabitants have been engaged by Prof. Hirohata (1), Prof. Sato (2), and Dr. Yo (3), either from the view of biochemistry, food chemistry or food-statistics.

Complete dietary studies would include an individual record of food consumption, full medical history and examination by competent physicians and suitable laboratory tests for mild or various nutrients, but those works are time consuming and expensive to conduct, and the interpretation of findings is often discouraging task because results are complicated by environmental and other factors which can be controlled only with difficulty. The simplest way of determining the diet of a community is to observe how much and what kind of food is consumed by the people according to their customs.

The influence of the tradition and the religion of the Formosan farmer may be the greater factors in the dietary customs. There are much more important roles than that in other countries, particularly in the cases of animal products. The diet of the Formosan farm family consists of a large degree of foods, rice, legumes, sweet potato, vegetables and domestic animal products, produced on its farm. Rice and sweet potato are principal foods ands the other subsidiary foods. Certain food stuffs to which more attenstion should be given, are prepared with the aid of fungi from leguminous seeds, either ensure that they can be preserved for a long period in the cheapest way or to

make them more digestible. These food stuffs consists of the main sources of proteins in the daily diet, in exception of the festival days and the farming seasons; only on festival days and during the farming seasons the farm family has more nourishing foods, such as meats, fishes and poultries.

It is a very interesting observation in the region that the amount of the sacrfice on festival may be proportional to the member of the altar in the family. For example, when a family has two altars, two sets of sacrifice become necessary and a piece of meat and certain quantity of fish and poultry are essential for each set of the sacrifice.

It very often happens in the region that, although the domestic pigs are usually marketed, its fat is restored for the family use. In regards to vegetable oil consumption, the family has a large legume production and the legumes are utilized for the oil supply.

On the basis of these observations or considerations the writer records the consumption of foods, rice, sweet potatoe, vegetable oils, legumes, vegetables, table salt and animal products, for a year by question and answer method when he visited the farm families of two selected communities which seem to be at a fair living level in Formosan farm.

The data will give us a clear picture as to the distribution and proportion of caloric intake, fat, protein and mineral intakes and as to some rough evaluations concerning to vitamins.

Data and Discussion

The farms considered are members of the Rural Economic Exerimental Station of Taiwan Province. One is named Sou-Chin-Liao Branch station and the other called Tai-Chung. 42 families from the former and 71 from the latter were selected for this investigation. A special attention is paid to that the family selected lives at a middle level among the farm, but its life may be situated at fair among Formosan farm. The sum of members is 501. The average member in the investigation is 7, the smallest 2 and the largest 21. Most of the families borrowed their cultivated farm from the Rural Economic Experimental Station. Only a few have their own small pieces of farm. Over majority of the inhabitants are farmers. Only a negligible member of them earns their living as a day-worker.

During the investigation the writer visited the families of two farms, then questioned as the kind and the quantity of foods they consumed in a year, from the autumn, 1947, to the summer, 1948, and their answers were recorded by the writer in July or August, 1948.

The average value of food-intake is expressed on the basis of an adult male unit by using Lusk's cofficient (4) given in the Table 3, because the error due to the difference in age distribution among population can be avoided.

In the calculation of the heat value from the nutrients the analytical data for the Formosan food products is not enough, so the writer is compelled to use the values

described in Kitayama's Table (9) and the Hand Book' (18).

In the fraction of utilization of fishes, the average analytical value between Funa (Carassius auratus) and Tunmy (Thunnus orientalis) is adopted as fresh one, and the value of Saury (Cololubis saira) as salted. Those are the common fishes eaten by the people in the regions. Nakae (4) reported that only 52% of the body of fish were actually eaten, but the writer used 50% in the computation for the sake of simplicity. In the case of poultry the author assumed 70% utilization in the computation, because no report of such estimation has ever been published. The composition of the processed soybean has been reported by Wei-Yung Lee (6) and by Sato (7), but the composition of such processed products have a very great variation. The writer, therefore, estimated their components directly from the weight of soy-bean itself. The heat value derived from unit weight of various nutrients is calculated according to Oshima's factor * (8), namely 3.9 cal./gr. for protein, 8.0 cal./gr. for fat and 4.1 cal./gr. for carbohydrate.

In the investigation of the vegetables a special attention has been paid to the mineral constituents, so that comparison was made by computing their phosphorous, calcium, iron and potassium contents. Each mineral constituent of vegetables is computed from Yo's table (3) which showed the average for the main vegetables consumed in Formosa, and the other foods are calculated from the tables of Kitayama and et al (9).

In the calculation of essential amino acid contents from protein of foods there are utilized the values reported by Block and Bolling (10) and Sato (11). In the estimation of vitamin content of foods the writer used the table prepared by Kawasaki and Ogawa (26).

* The factors were calculated on the basis of the digestible protein of Japanese foods.

(1) In. Shou-Chiu-Liao Branch Station.

The results investigated were summarized in the tables. Kleiner suggested in general way that normal men required from 3000 to 5000 cal. per day as the heat value when doing hard work (12). Food and Nutritional Board recommends 4500 cal. for the heat requirement of very active American man (13). In Buck's Land Utilization, Maynard (14) has shown that allowance is made for the smaller size and lower metabolism of the Chinese in taking 2300 calories as the minimum standard intake of energy value for an adult male. Hence it seems sufficient for requirement of the farmer investigated that the farmer daily takes 3457 cal. for an adult male unit.

The nutritive values of the average of the farmer investigated are compared with the statistical results (15), (16), (17), (18), (31), (3), published by other investigator in China or other countries. In the figures presented in Table 4, the average diet of the farmer investigated is similar to the same amount of caloric intake as compared with inhabitants in most other locations or countries, except Philippinos who have taken less protein, fat and caloric intake. But the Formosan farmer had a high consumption of carbohydrates and its amount is equal to that which found in certain locations of

China main land and other oriental countries.

The protein requirement according to John B. Youmans (19) or N. D. Heal (20) should be as high as 80 gr. to 100 gr. per day for a man having average size and average weight, and having considerable mechanical works. The Food and Nutrition Board of National Research Council (13) (in U.S.A.) also recommends that the protein requirement should be 70 g. According to Sherman (1930) the proper portion of proteins in the diet should furnish 10 to 15% of the total calories (21). Generally for the reason that plant proteins are biologically inferior to animal proteins, certain proportion, perhaps one third or more of these proteins, required be should animal origin foods.

In the farm investigated, the amount of protein taken by an adult male is 107.2 gr. per day, equal to 12.1% of the total calories. Of the amount, animal protein is 8.3 gr., corresponding to 8.6% of the total protein. Thus it is clear that protein supplied sufficient to the farmer in quantity but poor in quality. Renewed interest in the protein requirements of the essential amino acids for man was led to a redefinition of protein requierment in terms of the individual amino acids and an evaluation of diets on this basis. Block (10) has suggested allowances for the amino acids based on analyses of an average American diet and on calculations from the amino acid requirement of rats. Several objections can be made to the figures and agree in the opinion that the allowances are too high (22). Stare et al (22) have also suggested a closer approach to actual requirement from the calculations based on the amino acid composition of high quality proteins, for example, egg protein, which is highly digestible and completely utilized. When the values calculated by Block or Stare were used in comparison with the data investigated, it is evident that only lysine and leucine are slightly lower than the standards. A slight shortage of two amino acids proves an inadequate intake of proteins in quality, which means poor in animal products. According to Okada's report (15) the muscularworker in Chinese mainland takes far more protein than the Formosans (shown in the Table). In the exception of Okada's report, protein intake of the farmer is generally equal to the value obtained in the other locations or countries. For the safety of the protein nutrition of the farmer the animal protein supply should be increased twice or more, and some portion of the source of vegetable protein should be reduced. But, with the consideration of the extremely important medical finding developed and emphasized by Youman (19), —— with a high caloric diet the protein intake may be reduced safely to a very low level,—— and with the remembering the high consumption of rice and sweet potato, we see that, the probability of protein deficiency becomes very small or absent.

The daily fat supply indicates 46.7 gr. for an adult male and it occupies 11% of the total caloric intake. Comparing this value with those in other locations and countries, it is no remarked difference in an exception of that in Phillippine. Burr and Burr (23) have shown that skin lesions occured to rats when a fat deficient was given and that the sickness was cured by the addition of linolenic, linoleic or arachidonic

acid or addition of fats containing these unsaturated acids to their foods. Van Heen (24) has stated that in the most prosperous region in Java, the total fat consumption per capita per day amounts of 5 to 12 gr. per adult of 50 Kg. weight with a consumption of 2600 Cal. He is, therefore, of the opinion that one should not speak about a requirement-norm for fat, but only of a habit-norm, and that the danger of linolenic acid deficiency (should this occur in man) is very small, since fats from rice and maize and the principal non refined fats in Javanese food (coconut fat and peanut oils) contain a sufficiency of these fatty acids. Tadokoro and Saito have an experiment (25) that the diet containing higher fat has an adequate effect to rats living at higher temperature. Thus it is concluded with a certain safety that the intake is fair for the farmer.

Elvehjen has suggested that the optimal daily mineral requirment was 0.7 to 0.8 gr. for Ca, and 12-15 mg. for Fe, and Ca/P ratio is 1.0 to 1.2. (33)

The daily intake of Iron is 1.142 gr. for an adult male, which is over the standard. The intake of Ca is 0.593 gr. per day per adult male, indicating a clear shortage, and the phosphorous, 1.2359 gr. a marked surplus. It has been noted that Ca/P ratio is 0.48, far less than the standard and the possible reason is the larger consumption of rice and legumes which are too poor in Ca and rich in P.

The higher apparent consumption of table salt is given by the considerable large amount of various pickles and salted products used as the ordinary diets of the farmer. However, it may be advantageous for higher potassium consumption, whose daily intake of the farmer is 1.757 gr., but the normal requirement is 0.06 gr, for an adult male per day (26).

While the writer is fully consious of the importance of vitamin supply in the farm, no complete analytical data is available and the writer fails to make a detailed description in the terms. Only with the aid of the table published by Kawasaki (28), some rough conclusion for the nutritional state of vitamins may be drawn bellow, and the further examination would be obtained with the aid of clinical and biochemical surveys. Although it is unsafe to conclude that the vitamin A intake is a complete adequate, it appears that there is no serious deficiency in the region, because of the larger consumption of green vegetables. Of all foods in the farm diet, rice shows highest net content of vitamin B_1 than the other. But, it may be a possible damage of the vitamin during milling, and cooking. External temperature has great innfluences on the utilization of vitamin B noted by Mills (27). The vitamin B_1 supply may be exposed itself to the danger of deficiency. If enough care is taken during cooking or other processing of their foods, vitamin C may be kept in good effective state and it may be no worry about its deficiency, because the farmer has a larger consumption of vegetables. It is a interesting fact that Tang et al (32) reported a slight deficience of the vitamin (c) on the blood examination of some student of Taiwan university.

(2) Tai-Chung Branch Station

The data in the region are collected in the tables (V, VI, VII, and VIII).

General figures are similar to those in Shou-Chin Liao.

Special attention should be regarded to the higher consumption of sweet potato which leads to 820 gr. per man per day. The possible reason is that this value contains lots of sweet potato for the feeding uses. The apparent heat value, 4156 Cal. per adult per day, is over the requirement.

It is favourable that the intake of lysine is over the Block's allowance estimated as a man of 60 Kg. weight and leucine is close to the allowance, on account of the high intake of peanut. Thus it reduces the danger of protein deficiency or removes the danger.

As regards vitamin and mineral intakes, there are still unadequate state, similar to the case of Shou-Chin-Liao, except Ca. Ca intake given in the Table 8 is fair in comparison with the standard. However it should be remembered that calcium forms insoluble salts with a number of the anions (2) which occured in the intestinal canal. For example, the calcium of all vegetables actually tends to depress the absorption of Ca from other foods. This may be due to formation of oxalates, or phosphates, or to an influence of pH of the intestinal contents (2), (12), (30). Thus, the net supply of Ca will be lower than the apparent and the ratio of Ca/P may be unsafely.

Conclusion

The writer obtained the record for the preliminary information of Formosan farm.

Special attention was paid to the recording plan, which was based of the dietary life characterized with the tradition and habits of Formosan farmer. Then the record is collected by the question and answer method when the writer visited the farm families.

Shou-Chin-Liao and Tai-Chung Branch Station of Rural Econmic Experimental Station of Taiwan Province, are selected for the examination. The former situates on the southern Formosa and the latter on the middle Formosa. It may be judged from the observation that the farm family is living at fair level.

The farmers investigated have sufficient heat values from their foods as compared with the normal requirement and the values for the other oriental people.

The daily intake of protein for an adult male is more than 100 gr. The animal proteins occupy less than 10% of the total protein, inferior in its quality. In Shou-Chin-Liao, it shows a slight shortage of lysine and leucine when compared with Block's allowance. But Block's allowance is much too high in several objection and Youmans found in medical view that with a high caloric diet the protein intake may be reduced safely to very low level. Then the writer concluded the danger of protein deficiency is very small or absent.

The daily fat supply per adult, 46.7 gr. in Shou-Chin-Liao and 53.4 gr. in Tai-Cung, is an adequate state.

It is evident that Ca intakes are unsufficient, because the intakes are lower than

the standard and the values of Ca/P ratio are below than 0.5, whereas the standard requires 1.0 to 1.2 of the ratio.

Having no complete analytical results concerning to vitamins, the writer fails to draw such a clear data as the other nutrients. But a rough evaluation shows the danger of an unadequate vitamin B_1 supply and a possible fair supply of vitamin A. To vitamin C, it still remains a part to conclude.

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Table 1. Analytical Results of Foods

	Nutrient, % for foods.			Amino acid, % for food proteins									Mineral, % for foods			
	Protein	Fat	Carbohydrate	Lysine	Tryptophane	Phenylalanine	Cystine	Methionine	Threonine	Leucine	Isoleucine	Valine	Fe	Ca	P	(K)
Rice	7.72	0.77	76.79	3.2	1.3	6.3	1.3	3.4	3.9	7.7	5.1	6.4	0.001	0.009	0.069	0.070
Sweet potato	1.11	0.43	20.94	4.90	—	—	2.65	—	—	—	—	—	0.001	0.019	0.045	0.397
Lard	0.26	99.04	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vegetable oils	—	99.99	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peanut	28.47	45.81	11.28	3.0	1.0	5.4	1.6	0.9	1.5	5.5	3.5	4.0	0.002	0.071	0.399	0.654
Pork	20.37	17.50	0.27													
Chick	21.33	4.55	0.75	9.6	1.2	4.5	1.1	3.2	5.3	12.1	3.4	3.4	0.005	0.058	1.078	1.694
Duck	22.65	3.11	2.33													
Goose	14.21	44.26	—													
Fish, fresh	17.53	1.16	—	5.7	1.2	4.8	1	3	5	10	4	4	0.0055	0.109	1.148	0.091
Fish, salted	28.71	6.59	—													
Soy bean	35.81	16.83	25.85	5.4	1.6	5.7	0.6	2.0	4.0	6.6	4.7	4.2	—	0.230	0.049	2.095
Vegetable	2.85	0.66	6.73	5.0	21.0	4.5	1.8	2.3	4.8	11.0	5.4	6.0	0.187	0.069	0.009	—
Fish, dried	58.70	4.28	—	5.7	1.2	4.8	1	3	5	10	4	4	0.0055	0.109	1.148	0.091

Table 2. Vitamin Contents of Foods

	A	B	C
Rice	0	1.85	0
Sweet Potato	0.1	1.2	0.3
Legumes, dried	0.0 (Trace)	5.0	0.0 (Trace)
Legumes, fresh	2.0	1.0	0.2
Pork	0.0 (Trace)	10.0	0
Poultry	0.0 (Trace)	0.5	0
Fish, fresh,	0.0	0.5	0
Fish, dried,	0.0 (Trace)	1.0	1.0
Vegetable, white leafy	1	0.5	0.5
Vegetable, green leafy	70	0.3	0.5
Vegetable, tuber,	0	0.3	0.2
Vegetable, fruity	0.5	0.3	0.1

Table 3a. Lusk's Factor for Computing the Adult-Male Units and the Computed Values in the Regions

	0 to 6 both sex,	6 to 10 both sex,	10 to 14 both sex,	14 + females	14 + males
Lusk's factor	0.50	0.70	0.33	0.83	1.0
Computed value Choun Chin Riao	24.5	34.3	43.16	78.0	107.0
Computed valus Tai-chung	32.5	38.5	60.59	126.99	154.0

Table 3b.

	Total member in the region before computation	Total value after computation	Factor for calculaiton *
Chou Chin Riao	351	286.98	1.22
Tai-Chung	500	412.63	1.21

* Factor=Total member/Total value

Table 4. Daily Intake of Protein, Fat & Calorie per an Adult Male Unit Compared to the Value Given the Other Countries & Locations.

		Protein (gr.)	Fat (gr.)	Calorie	Protein/Calorie %	Animal protein /Totalprotein %	Reference
Taiwan	Chou Chin Riao	107.2	46.1	3,457	12.1	8.6	—
	Tai-Chung	115	53.4	4.156	—	—	—
China	Average	100	—	—	12	—	14
	Wheat Region	108	—	—	14	—	
	Rice Region	91	—	—	11	—	
	(Muscle-Worker), , in Autumn	146.0	38.2	4,129.9	—	—	15
	〃 , in Winter	142.2	41.8	3.878.2	—	—	

Korea	(at a fair liveing level)	116.46	53.09	2,363.46	—	—	16
Philipine	in rural communities	63	20	2,182	—	—	17
	in towns	63	33	2,107	—	—	

Calorie Distribution

		Cereal (mainly tice)	Animal protein	Milk & dairy product	Fruits, Vegetables & legumes	Suger Candy & fats	
Phillipine		83.3%	6.6%	0.1%	7.8%	2%	33

Table 5. Average Daily Intake for a Male

	I. Chou Chin Riao	II. Tai-Chung
Rice	654.0g	612.0g
Sweet potato	42.0	820.0
Lard	18.0	7.8
Vegetable oils	1.8	8.4
Peanut	7.2	12.0
Pork	12.0	10.8
Chick	4.2	3.78
Duck	0.42	1.26
Goose	0.84	7.56
Fish, fresh	51.0	7.5
Fish, salted	2.91	1.8
Soy bean for a pickled-curd	5.04	17.48
Soy bean for soy source	14.00	10.50
Soy dean for a pickled-soy bean	3.50	6.3
Table salt	60.00	52.4
Vegetables	492.00	444.00
Fish, dried	3.78	7.2

Table 6. Daily Intake of Nutrients for a Member and an Adult Male

	for a member		for an adult	
	Chou Chin Riao	Tai-Chung	Chou Chin Riao	Tai-Chung
Protein	87.91gr.	95.15gr.	107.2gr.	115.1gr.
Fat	38.21	44.14	46.7	53.4
Carbohydrate	546.21	677.74	—	—
Calorie	2834.0	3435.0	3457.0	4156.0
Table salt	60.00	52.4	—	—

Table 7. Daily Intake of the Essential Amino Acid for an Adult Male Compared with Calculated Values for Amino-acid Requirement of Man (70kg)

	The value for the requirement		Data for an adult	
	Block	Stare	Chou Chin Riao	Tai-Chung
Lysine	5.2gr/day	1.4gr/day	4.09	4.88
Tryptophane	1.1	0.4	1.40	1.39
Phenylalanine	4.4	1.4	5.78	5.95
Cystine	} 3.8	{ 0.5	1.32	1.59
Methionine		1.4	3.00	3.03
Threonine	3.5	1.2	4.12	4.25
Leucine	9.1	3.6	8.43	8.68
Isoleucine	3.3	1.3	5.21	5.06
Baline	3.8	1.3	5.82	5.84

Table 8. Daily Intake of Minerals for an Adult Male

	Chou Chin Riao.	Tai-Chung.
Fe	1142.6 Mg/day	120.6 Mg/day
Ca	593.2	769.8
(K)	1757.1	5919.2
P	1235.9	1867.4
Ca/P	0.48	0.41

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中　文　摘　要

作者記錄臺灣省農村中的食物資料，作這初步調查報告。調查設計之初，首先注意農民膳食生活上的傳統習慣。在作者訪問農場中每戶人家時，用口頭問答方式，加以記錄。地點選定臺灣省實驗經濟農場的手中寮與臺中兩分場；前者位於臺灣省南部，後者是在中部。據考察該二處的農民生活，是在一般水準以上，農民從食物中攝取的熱量，已經足够，而比之遠東若干國家的標準需要量亦多。每一成人每日攝取的蛋白質，超過100g，動物性蛋白質所佔比例低於10%，在質方面似嫌稍劣。在手中寮分場，氨基酸類中的 Lysine 與 Leucine 二種，比 Block 的標準稍爲缺乏，但有人認爲 Block氏的標準過高，而加以反對。 Youman 認爲熱量供給過剩時，可以減少蛋白質的攝取量。故作者推斷

上述二處之蛋白質缺乏的程度，微不足道，或竟可說沒有缺乏。

每一成人，每日攝取的脂肪量，手中寮是 46.7g，臺中 35.4g，情形尚佳。

兩處食物中的鈣量，均不充分，顯然是較標準需要量爲低。兩處的鈣燐比皆在 0.5 以下，而標準量是1.0～1.2。

生活素方面，得不到詳細的分析資料，故作者不能提出一用數字的詳盡說明。但經粗略評定，已知生活素乙可能欠缺，生活素甲足够需要，至於生活素丙，則尚須進一步加以研討，目下暫缺不論。

芒果炭疽病及其防治試驗

（附落果觀察）

孫　守　恭

一、緒　　言

臺灣南部氣候條件，頗適於芒果（Mangifera indica, Linn.）之栽培。然而芒果栽培之一大困難，尤其是作爲經濟栽培，以收穫果實爲目的時，炭疽病（Colletotrichum gloeosporioides Penz.）的發生最爲嚴重。炭疽病的病徵在成熟果實上特別顯著，病斑初呈黑色，凹陷，圓形；病之後期往往數斑滙合成一大黑斑；在樹上，有時發現自芒果柄部向下蔓延之炭疽病傷痕；在幼果時，炭疽病多發生於柄基周圍以及果柄上，呈褐色，病斑不規則形；除果實外，有些地區炭疽病使花穗凋萎（Blossom blight, Cook 1913, Baker 1938, Mckee 1940）；尤其是在濕季開花時，情形最爲嚴重。臺灣南部，芒果開花期適逢乾季，花穗萎凋不太嚴重。此外炭疽病菌又可引起葉斑病（Mckee 1940），葉凋病（Rose, Brooks, 及照屋全昌等著書），梢枯病（Ross, Brooks, 1943）；在通常情況下，新枝隨時可被侵害，造成傷斑（lesion），新枝上之傷斑，周年可見，可能爲炭疽病菌傳佈之淵源。

對於栽培者，炭疽病可致使花穗凋萎，落果增多，使成爲開花不實，產量減少。在販賣者，果實易腐，不宜久置，若四五日不能售出，卽失去商品價值；消費者則極難得到新鮮美觀的果實，一般所見都是病斑點點，污穢不堪；罹炭疽病之果實，遠途運銷，尤感困難；由西印度群島之 Trinidad 運往英國之芒果，均在冷藏設備下，但一脫離冷藏後，腐爛迅速，且多爲炭疽病（Wardlaw 1936）。據筆者1949、1950年之觀察，在高雄鳳山市場之芒果，極少完全無病者。

Colletotrichum sp. 之爲害芒果，多在果實充分成長之前，而病則發生於果實成熟之後，此卽所謂「潛在感染」（Latent Infection）之特性（Baker, Wardlaw, 1937）。Baker（1940）等研究結果，謂成長之芒果，病菌不易侵入；但花後二週之幼果，卽有感染，並潛伏其內。故芒果炭疽病之防治實施，須由花期開始，在結果期內不時撒佈，方可收效。

二、芒果炭疽病之分佈

1. 中央美洲各地（加勒比區 Caribbean Region）：

Antiqua, Borbuda, Bardados, British Guiana（英屬圭亞那），British Honduras（英屬洪都拉斯），cuba（古巴），Grenada, Haiti（海地），Jamaica（牙買加），Martiuique，Puerto Rico（波多黎科），St. Kitts，St. Lucia，St. Vincent，Trinidad，Tobago Guadeloupe，Dominca。

2. 南洋　爪哇

3. 美國　Florida（佛羅勒達），Hawaii（夏威夷）。

4. 中國　臺灣，廣東，福建，海南島。

5. 香港。

6. 印度。

7. 菲律賓。

三、沿　　革

1913年 Cook 氏在其所著之『熱帶植物病害』一書（The Diseases of Tropical Plants）中，曾述及芒果之花凋病（Bloom blight），係由於 Gloeosporium mangifeare 所致，並言波爾多液可以防治之；1914年 MuMurran 發表其在美國 Florida，關於芒果炭疽病之研究，謂濕季中芒果之花凋病極嚴重，且在雨季中撒佈波爾多液，收效極少；1936年 Wardlaw, Leonard 在其芒果貯藏試驗中，發現貯藏期中之損耗，大部由於炭疽病；1937年 Baker 及 Wardlaw 氏研究數種果物在貯藏期中之病害感染型（Types of Infection），發現芒果炭疽病菌有『潛在感染』（Latent Infection）之特性；1938年 Baker 氏以1%之炭酸鈉波爾多液（Burgundy mixture）作防治試驗，自花期開始撒佈，每週一次，直到成熟期，所用芒果品種爲 Julie 及 Peter 種，地點在西印度群島之 Trinidad；結果撒佈區果實之貯藏期較未撒佈者多 3～4 天，未撒佈區果實之腐爛，由於炭疽病者佔 98～100%，而撒佈區爲19～34～44%。1940年 Mckee 復在同地作防治試驗，仍以炭酸鈉波爾多液爲材料，測定撒佈適期；結論謂防治效果與撒佈次數成正比，而開花後期撒佈較前期者好；果實收穫後，貯藏期內之良好率，花期 3次撒佈區爲4～18%，15次撒佈區爲26～36%，全期撒佈區(25次）爲33～35～60%，對照區爲零。1943年 Ross, Brooks, Bratley 等氏，謂芒果炭疽病之防治，甚爲困難，因易罹病之幼嫩枝葉，隨時都在生長中，且花穗部份，殺菌劑附着較難；氏等謂3～3～50式(約0.7%)波爾多液加以粘着劑，防治甚爲成功。

四、供試材料及試驗方法

本試驗旨在臺灣南部測定防治效果。所用藥劑爲波爾多液與石灰硫黃合劑。波爾多液之濃度爲0.5%，等量式；硫酸銅爲結晶體者，生石灰自市上購得，質不良，含量不太理想；石灰硫黃合劑爲鳳山分所原存之製成品，母液濃度爲 29°Be'，撒佈濃度爲 0.2°Be'；供試芒果品種爲本地種(桃樣仔)，共四株；A 株石灰硫黃合劑，B 株爲對照，C、D 二株爲波爾多液；除 C 株本年未開花外，其餘三株於1949年12月中旬左右花芽開始抽出。本試驗藥劑撒佈自1949年12月26日開始，每半月撒佈一次，至1950年6月10日止(成熟期)，共撒佈12次，每次用藥量自20立升至25立升(5.3～6.6加侖)。

芒果花期約至1950年1月底止，2月初卽有極小幼果，但該時落果尚少，自 3 月22日起，逐日檢拾落果，清水洗滌，置於玻璃鐘罩內，歷時24至36小時，然後以擴大鏡或顯微鏡將每一落果加以檢視，分炭疽病、蟲害及其他三項記錄之。自 6 月17日，將成熟果實（已充分成長，肩部綠色漸淡而微有軟者），分批採收，以清水洗之，置於室溫下，歷五日，調査炭疽病個數，健全無病之個數，其他非炭疽病致腐者之個數，以及自然老熟而軟化者之個數。果實採收至 7 月 5 日全部完畢，最後在各植株

間隨機抽樣40本，調査嫩枝罹病率，葉斑病（Pestalozzia Mangiferae P. Henn.）亦附帶調査一次。

五、試 驗 結 果

1. 落果罹病考査

自3月22日起，逐日檢拾落果，加以觀察；早期落果自花後一月半（45日）至二個月半(75日)期內最多；果實甚小，病斑多在果柄及果實之肩部。全部落果總檢査概如下表：

表一　落果罹病率（自3月22日至6月16日）

處理別	落果總數	炭疽病%	蟲害%	其他%
對照	780	28.33	2.18	69.49
石灰硫黃	646	15.48	2.01	82.51
波爾多液	365	2.19	1.37	96.44

註：落果原因除由炭疽病與蟲害外，餘均歸於其他項下，生理的或機械的成分居多。

依上表，0.5%波爾多液之防治效果甚好，炭疽病率僅2.19%，而對照株爲28.33%，石灰硫黃合劑雖較對照爲優，但較之波爾多液則甚劣；蟲害（喰心蟲等）的落果佔2%左右；其他項下之落果，概屬於生理的落果或機械的，如風害、水份不足、受精不完全（機構的缺陷或生理的）、營養不充份與果實生存競爭之結果。

2. 成熟果實之觀察

自6月中旬，果實逐漸成熟，所採成熟標準，係果實尙呈綠色，惟肩部綠色已較淡，以指壓之，微覺軟者；採收後，以淸水洗之，置於室內溫度下，貯藏五日，觀察炭疽病罹病率(結果如表二)；由表二知波爾多液之效果仍屬優良，其防治效果爲83.73%(以對照爲基準)；而石灰硫黃合劑之防治效果僅爲13.05%；對照株之果實，貯藏力極小，不到三日即行腐爛；石灰硫黃合劑與對照無顯著差別，且兩區之果實於採收時即已汚穢不堪；貯藏五日後，健果極少，但波爾多液撒佈之果實，健果佔69.11%，貯藏期中，果色呈美麗之黃色，貯藏可延至一週有餘，一週以後，果實乃呈乾縮，但炭疽病很少。

表二　成熟果實貯藏五日後罹病率觀察

處理別	收穫總數	炭疽病		老熟		其他		健果	
		個數	百分率	個數	百分率	個數	百分率	個數	百分率
對照	47	34	72.34	0	0	6	12.77	7	14.89
石灰硫黃	62	39	62.90	3	4.84	11	17.44	9	14.52
波爾多液	68	8	11.77	5	7.35	8	11.77	47	69.11

註：1.『老熟』係自然過熟而起軟化者。

2.『其他』係蟲害、裂果或非炭疽病引起之敗壞。

3.『健果』係貯藏五日後，仍保持金黃色之美觀，硬度適中者。

3. 各處理株果實成熟率比較

芒果開花極多，但極難全部結果，尤以在濕季開花之環境下爲顯著。除生理的原因外，炭疽病之關係至大 (Cook 1913， MuMurran 1914， Baker 1937)。殺菌劑之撒佈，可以抑制花穗腐敗，增加着果率，減少落果。由各株成熟果實百分率，可窺知處理間之差異甚大(如表三)。對照株之成熟果僅爲全部着果數之5.68%；石灰硫黃株爲8.78%，波爾多液株則爲15.70%。卽波爾多液區較對照增加收量276.4%，較石灰硫黃株增加190%；石灰硫黃對於芒果炭疽病之防治，無大效果；但在收量上亦較對照株增加154%。

表三 藥劑處理對芒果落果及果實成熟率之影響

處理別	落果		成熟果		總計
	個數	百分率	個數	百分率	
對照	780	94.32	77	5.68	827
石灰硫黃	646	91.25	62	8.78	708
波爾多液	365	84.30	68	15.70	433

4. 各處理株新生枝條罹病率及葉斑病調查

炭疽病除爲害花穗及果實外，在新生嫩枝上之病斑，周年可見。病菌侵入嫩枝表皮後，枝條之角質層 (Cuticle layer) 卽破裂，呈白色薄膜，而後形成不規則長形或長圓形傷痕。此病枝在對照株爲52.5%，石灰硫黃株45.0%，波爾多液區爲15～5%(見表四)。

表四 各處理株炭疽病病枝及葉斑病調查

處理別	炭疽病病枝(%)	葉斑病(%)
對照	52.5	42.5
石灰硫黃	45.0	50.0
波爾多液 (1)	15.0	27.5
波爾多液 (2)	5.0	17.5

註：波爾多液區共計二株，波爾多液(1)係鄰近對照株，故影響其罹病率較高。

葉斑病 (斑點病) 發生於新葉上，病原爲 Pestalozzia Mangiferae P. Henn. ，初時在嫩葉上呈紫紅色，微小斑點，後擴大爲圓形，外緣深褐色，中央部淡褐色，斑點周邊呈黃綠色，罹病後期中央部脫落成穿孔，以擴大鏡視之有圓形小黑點，病斑大小約爲 3～5 mm. ，自停止藥劑撒佈20天後，各株均有發生，但以波爾多液撒佈株爲輕。

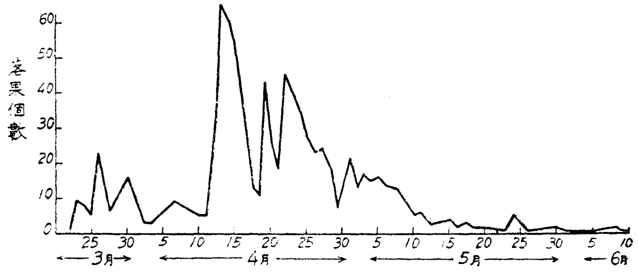
六、考察

1. 落果考查

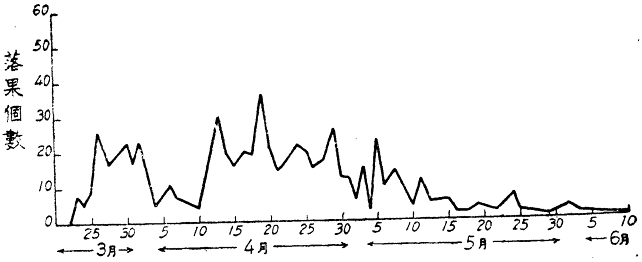
芒果自小果時期至成熟前，經常有落果，但落果中由於炭疽病而引起者，約屬全部落果四分之一弱 (指無藥劑撒佈者，參看表一之對照株)。波爾多液撒佈株，果實總數爲433個，其中落果佔 84.30%，在此84.30%之落果中，炭疽病引起者佔2.19%，僅爲四十分之一而已；換言之，防治效果較對照

株高10倍。石灰硫黄之效果約介於對照與波爾多液之間，除此之外之落果，蟲害原因極微，大部可歸之於生理的落果。芒果之生理落果，尙乏資料可考，據淺見與七(1942)之著書，一般果樹之結果期，皆有落果，除風害及病蟲害之原因外，均稱之謂生理的落果；並謂苹果豐收時成熟果率爲 10~15%(美國德國之觀察)，在吾人之試驗中，波爾多液處理株，成熟果率爲15.70%。

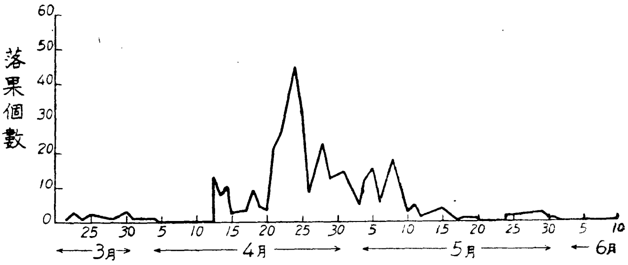
生理落果之情形，各種果樹有差異，Dorsey (1919) 謂李之落果有三個波相；Heinicke (1917) 謂苹果及梨之落果有二波相；佐藤氏 (1936) 謂桃之落果有三個波相；淺見氏(1936)謂柿之落果爲單頂曲線，吾人在芒果落果中之觀察，約有三個波相，但芒果之花期頗不一律，在臺灣南部，自11月至翌年2月，均有開花，故落果之波相亦不能定期，一般情形 (如一月開花時)，第一期落果在3月下旬，第二期在四月中旬，第三期在四月下旬，以第二期落果特多(參照圖一)。淺見氏謂落果原因，第一回落果多係雌蕊不完全，受精機能有缺陷；第二回落果係胚之發育停止或養分之不足；第三回係養分不足，榮養的自然淘汰。臺灣南部，芒果着果期適値乾季，水份之供給亦屬必要。又芒果之早期落果，常帶有極長之果柄(花穗)脫落，似有遺傳之因子存在。



圖一 芒果落果之波相(無處理)



圖二 芒果落果之波相(石灰硫黃處理)



圖三 芒果落果之波相(波爾多液處理)

2. 石灰硫黃之效果

石灰硫黃合劑爲殺菌兼殺蟲之藥劑。在此試驗中，對於成熟果實之炭疽病防治，殊無效果可言。但在着果期內，石灰硫黃撒佈，可減低落果。換言之，對於落果之炭疽病之防治尚有效果（參照表一）；但遠不及波爾多液。蓋石灰硫黃之防護效果，實微不足道，如將撒佈間隔縮短，可能增高其效力。

3. 波爾多液撒佈

0.5%之等量波爾多液，均勻完全撒佈於芒果枝葉果實上，每半月一次，可收圓滿之防治效果；且此濃度，藥害亦極少。除非在多量藥液凝聚於一點時，可以引起灼傷。在此試驗中，藥害很少發見，只有下列二種情形足可注意。

(1) 波爾多液撒佈與落葉——波爾多液撒佈數次之後，有促進落葉增多之現象，特別在乾旱之春季爲然。本試驗在撒佈六次之後，曾於第七次撒佈時（4月26日），作一調查，如表五所示。波爾多液處理株較對照株多落葉42%。此係波爾多液撒佈後、葉面硬化與蒸散作用較强所致。此種落葉情形，至濕季則行減少。故在乾季行波多爾多液撒佈時，可以灌水抑止之。

表五　各處理株落葉數比較

株　　別	落葉數 (個)	需蓋量 (立升)	樹蓋體積比	理論落葉數	較對照多落數 (個)	多落百分率 (%)
石灰硫黃株	1140	24	1	980	160	14
對照株	980	24	1	980		
波爾多液株(二株平均)	1020	14.5	0.604	591.9	42.81	42

(2) 波爾多液撒佈與煤病 (Sooty mould)——波爾多液撒佈後，介殼蟲與木蝨之繁殖增多，葉煤病隨之發生 (Mckee 1940)。此乃波爾多液將介殼蟲之天敵寄生菌類殺死所致。在本試驗中，亦有此種情形發生，特別於枝葉密集之處顯著。Mckee 氏建議加油劑於波爾波液中以防止之。至於其他有效方法，尙須試驗之。目前新興殺蟲藥劑極多，如 BHC、DDT 等，不難找出有效而便利之防止法。

七、結　　論

芒果炭疽病 (Colletotrichum gloeosporioides)，在臺灣發生極普遍而嚴重。本試驗以0.5%等量波爾多液撒佈，每半月一次，自開花始，至成熟期止，防治效果極爲圓滿，可以減少落果，增加收量，對炭疽病之防治效果達48%。本試驗對芒果之落果波相，亦曾作一連續之觀察。

39年8月於鳳山熱帶園藝試驗分所

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第十八次　昭和13年(1938)
第十九次　昭和14年(1939)

MANGO ANTHRACNOSE AND ITS CONTROL EXPERIMENT

(With reference to the dropping of young fruits)

Fengshan Tropical Horticultural Experiment Institute

S. K. Sun

Summary

1. This experiment was carried out at Fengshan from December 1949 to the July of 1950. The purpose of this experiment is in measuring the effectiveness Bordeaux mixture and lime sulfur to control Mango anthracnose (Collectotrichum gloeosporioides Penz.), an epidemical disease of Mango (Mangifera indica, L.).
2. Anthracnose (or black spot) always causes a great damage of Mango fruits after harvesting.
3. There are 28.33 per cent of young dropping fruits and 72.34 per cent of rippen fruits being estimated due to anthracnose.
4. The spray schedule was held once biweekly, began at the time of the flower cluster blooming and ended a week before harvesting. The Concentration of Bordeaux

mixture applied in this experiment was 0.5 per cent, (approximately equivlent to the formula 2-2-50) and that of lime sulfur was 0.2 Be'.

5. The application of Bordeaux mixture reduced the diseased fruits to 84 per cent, The percentage of maturing fruits obtained by Bordeaux mixture spraying was 15.70 while that of lime sulfur applied in comparison with untreated trees were 8.78% and 5.68% respectively.
6. In view of Spring and Winter are dry seasons at Fengshan the application of fungicides once or twice a month are satisfactory.
7. The phase of the young fruit dropping which is of physiological importance was also observed during the period of this experiment.

甘藷新引進品種特性觀察

王　　　俠

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(一) 緒　　言

甘藷爲熱帶原產之作物，性好高溫，在高溫環境下，概均開花結實。臺灣位于熱帶與亞熱帶之間，終年氣候溫暖，大部分甘藷品種，均可正常開花結實，而尤以嘉義之地理環境爲最理想。日治時代即選定嘉義分所爲甘藷雜交育種之中心，研究工作歷時二十餘年，目前本省栽培甚廣之臺農種，即爲其不可埋沒之業蹟。

考査甘藷之育種事業，在一般農作物中發展最遲爲時不過二三十年之久，更因受地理環境之限制，溫帶區域對甘藷之改良方法，僅能採用引種、選種及利用突變等法，故其成功機會遠遜于利用雜交方法，自不待言。

光復以還，臺灣重入祖國懷抱，本分所利用甘藷在嘉義正常開花結實之優良環境，期策動全國甘藷之改良工作，旋與國內各省農事機關取得合作，於民國三十五年至民國三十七年，先後徵得甘藷品種七十餘種，藉作甘藷雜交育種之材料，其目的旨在觀察是項新引進品種之特性，期以獲得優良親本，育得糖分高品質良而豐產之品種，以裕民食是所厚望也。

本文承楊所長致福及孫貽謀先生指示，並承楊所長及楊主任景濳校閱特誌謝忱。

(二) 材料來源及氣象與栽培概況

A. 引進品種名稱及引取地點與時間

品種號數	引進品種名稱	引取地點	引進時間(年、月、日)	品種號數	引進品種名稱	引取地點	引進時間(年、月、日)
1	連城齒老種	福建	36. 7. 1	37	洋　　　薯	南京中農所	37. 2. 17
2	連城五齒老種	〃	〃	38	Sp 4 —— 4	〃	〃
3	連城新種(一)	〃	〃	39	合川大籐子	〃	〃
4	〃 (二)	〃	〃	40	風吹底	嘉義	36. 12. 1
5	冲川種	〃	〃	41	假英國種	〃	〃
6	永安閩農試場種(一)	〃	〃	42	永春五齒	福建	37. 3. 12
7	〃 (二)	〃	〃	43	白尾白	〃	〃
8	紅尾種	〃	〃	44	紅心粒	〃	〃
9	臺灣白	〃	〃	45	紅尾白	〃	〃
10	番仔薯	〃	〃	46	蛋黃紅	〃	〃
11	臺灣二號	〃	〃	47	黃　　　藷	〃	〃
12	芬　　　薯	〃	〃	48	蕃茹芋	〃	〃
13	七十二日種(一)	〃	〃	49	寶圓売	〃	〃
14	〃 (二)	〃	〃	50	六十日藷	廣西	37. 3. 16
15	六十日早	〃	〃	51	紅皮藷	〃	〃
16	閩農試場金瓜	〃	〃	52	南瑞苕	福建	37. 3. 12
17	四川種 2	四川	35. 11. 1	53	松陽 23	浙江	37. 4. 10
18	〃 3	〃	〃	54	〃 41	〃	〃
19	〃 4	〃	〃	55	〃 208	〃	〃
20	〃 10	〃	〃	56	〃 243	〃	〃
21	〃 19	〃	〃	57	嶺南一	廣東嶺南大學	37. 2. 6
22	〃 20	〃	〃	58	〃 二	〃	〃
23	〃 21	〃	〃	59	〃 四	〃	〃
24	〃 24	〃	〃	60	〃 五	〃	〃
25	〃 26	〃	〃	61	〃 六	〃	〃
26	〃 27	〃	〃	62	嶺 No. 1	〃	〃
27	〃 33	〃	〃	63	〃 No. 6	〃	〃
28	〃 34	〃	〃	64	〃 No. 16	〃	〃
29	〃 35	〃	〃	65	〃 No. 24	〃	〃
30	〃 36	〃	〃	66	〃 No. 36	〃	〃
31	〃 38	〃	〃	67	〃 No. 37	〃	〃
32	〃 39	〃	〃	68	Red Nancy	南京中農所	37. 9. 27
33	〃 40	〃	〃	69	Oklahoma 24	〃	〃
34	〃 47	〃	〃	70	冲繩(Okinawa)100(一)	〃	37. 10. 29
35	南瑞苕(Nancy Hall)	南京中農所	36. 12. 1	71	〃 100(二)	〃	〃
36	普利(Porto Rico)	〃	〃				

B. 氣象概況

第一年(民國三十七年)九月中旬插植後，九月下旬起至十二月上旬止，酷旱無雨，甘藷前期發育

當受影響；後期三十八一月起，氣溫突降，雖平均溫度爲13.7°C，但其高低升降差異頗大，一月十七日，會降輕霜一次，最低溫降至 2.5°C 爲嘉義 不常見之現象，部分莖葉與花芽均因霜害而受損，因此甘藷後期塊根之肥大，不無受其抑制，花數亦因而減少。

第二年(民國三十八年)與第三年(民國三十九年)九月間挿植，前期雖入旱季，但仍時有微雨，致前期甘藷莖葉充分發育，後期又因氣溫恒定，平均氣溫約 17°C 左右，塊根肥大不受阻碍，因此第二三年甘藷各品種塊根產量大多數均較第一年爲高；花數亦較第一年爲多。

三年氣象記載從略。

C. 栽培概況

1. 地　點：嘉義山仔頂嘉義農業試驗分所

2. 品種數：三十七年觀察六十七品種。三十八年，三十九年汰去二十五品種，另加入四品種共觀察四十六品種。

3. 苗床管理：(一)種藷圃：三十七年僅以引進之種藷或挿苗盡量繁殖爲度。三十八年三十九年，所觀察之各品種下種種藷每品種六個。種藷圃面積一平方公尺，二行植，每行三穴，每穴施適量堆肥作基肥，切除塊根首尾，塗以草木灰，以防腐敗，傾斜埋入穴中，上伏土約一寸，發芽後視苗生長强健與否酌施追肥(硫銨)一次，待苗長一尺左右卽剪取挿植至繁殖圃中。

(二)繁殖圃：(1)面積：每品種佔二平方公尺(1×2m)

(2)肥料：每小區(二平方公尺)施堆肥六斤作基肥，摘心後施追肥(硫銨)一次。

(3)株數：每品種挿植十二株，株距 1/3 公尺，二行植。

(4)管理：六月初挿植六月中摘心一次，隨時注意除草。

4. 本圃管理：

(一)面積：每品種一小區，小區面積(長 16.66 公尺寬 1 公尺)16.66 平方公尺每小區分五小段，每段長 3.33 公尺，每段挿植十株，株距 1/3 公尺。

(二)整地：八月中旬至九月上旬耕耙三次。

(三)肥料：堆肥 1/10公頃施 750kg.鉀肥：草木灰每小區 500g. 或硫酸鉀 250g. 硫銨每小區 170g.(半作基肥，半作追肥)。過磷酸石灰 250g.(全部用作基肥)

(四)採苗：挿植先一日，每品種各採先端八節苗五十株備用。

(五)挿植法：水平植。

(六)管理：

年　份	前　作	挿植期	補植期	中耕施追肥	除　草	灌　溉	翻　蔓
三十七年	陸　稻	9月11日	9月21日	10月11日	10月15日 10月28日	10月9日	11. 13
三十八年	陸　稻	9月20日	9月30日	10月20日	10月11日 11月5日	11月7月	11. 23
三十九年	靑皮豆	9月13日	9月23：	10月13日	10月11日 11月16日	11月13日	11. 15

(七)收穫：揷植後生育達四個月開始第一次收穫，以後達五個月、六個月、七個月各收穫一次，每次收穫一小段。

(三) 前人之研究

關于甘藷品種特性調査之研究，最早爲 Price(1893)氏，在 Texuas 州曾根據其葉形，將甘藷品種分爲三類，即全緣葉肩狀葉及缺刻葉三類。其次 Groth (1911) 氏，對甘藷品種特性調査項目規定，亦至爲詳細。其後 Thompson & Beattie 氏 (1922) 於 Baton Rouge, La.; Florence, S. C., Norfork, Va., Columbus, Ohio, 及 Watson, N. Y. 諸地，蒐集甘藷品種，詳細調査其特性，按其性狀而歸納爲八群，群下又分爲若干區，該種分類法之優點，可免除因地域氣候對甘藷特性所生之差異，故一般認爲該分類法似較完善。

日本對于甘藷品種特性調査及其分類，乃於(1925)(大正十四年)冲繩縣立農事試驗場最先開始研究，同年，日人和田歌吉氏對于甘藷品種特性調査，亦有詳細之研究，並將甘藷塊根形狀，分爲八類型，此爲對甘藷塊根形狀進行研究之嚆矢。其後牧野氏(1931)，曾就日本栽培之甘藷品種，發現在植物學上可分爲二變種，即 Ipomoea Batatas Lam. Var. Batatas Makino. 與 Ipomoea Batatas Lam. Var. edulis, Makino 二種。茲將二者之特性列下：

1. Ipomoea batatas Lam. Var. batatas Makino.

   莖細長，綠色或稍帶紫色，毛少，葉形多裂片，塊根大而豐產，藷皮光滑，多淡紅色，肉色白色，水分多蒸燒後柔軟。

2. Ipomoea batatas Lam. Var. edulis Makino.

   莖粗，紫色，多毛，葉形全緣，多心臟形與腎形，塊根表皮粗，肉色多黃色。此種原產於南美西印度，後分佈于美國中部，中國及印度等地方。

我國如黃弼臣氏，對于廣西甘藷品種之特性亦有詳細研究。

以上諸氏對于甘藷之研究，惜因其文獻闕如，致未能作詳細參考。

臺灣之甘藷品種繁moving，爲數不下四百餘種，臺中農事試驗場(1932)最先收集甘藷品種 193 種，作詳細特性調査。其後平間惣三郎氏及野田幸猪氏，曾先後蒐集臺灣之甘藷品種，作分類及特性之調査研究。野田氏曾將臺灣之甘藷品種386種，按 Thompson 氏之分類法，依照其性狀而歸納爲22群，群下又分爲若干區，且氏對于甘藷之開花習性，舉凡內在的 CN 比率， PH 値及外在的氣象栽培等因素，對其開花時期及花數之影響，均有詳盡之研究。平間氏調査 389 種甘藷品種之特性，調査項目至爲詳細，對甘藷之成熟期，塊根形狀，葉形及塊根皮色，肉色等性狀，更釐定有詳盡之調査標準。本文對甘藷品種特性調査所採用之標準與方法，除少數略有變更外，槪均採用平間氏之調査標準與方法。

(四) 甘藷引進品種特性調査標準與方法

甘藷引進品種特性調査項目，槪分爲葉、莖、塊根(一)、塊根(二)及花五大類，另莖葉收量一項則置于塊根(二)項內；茲將其調査標準與方法，按上述五大類分述如下：

A. 葉 (Leaf)

1. 葉形 (Leaf form)：

本項調査所採取之標準，乃根據其外形，葉緣，葉基，葉尖等形狀分爲五類：即心臟形，腎形，鼻形，戟形，裂葉是也。前四類復以其葉緣形狀，又各分爲全緣(原形)，波狀齒，齒牙狀，粗鋸齒等四種；裂葉有三裂葉與五裂葉兩種；其分裂之程度，又有深淺之別。總括之葉形之分類標準，約分爲二十類型，玆分列於下：

甘藷之葉形，不但品種間左異頗大，同株內頂葉至基部葉亦有差異，採取標準，每致無所適從，調査時至感困難，故調査方法，以頂葉下第六葉至第十五葉間，十葉之中，選擇具有代表其品種性狀之一，按下述之類型，而確定其葉形。

(1)心臟形 (Cordate)：葉身寬闊，基部凹入內方，先端尖銳，全體爲心臟形。

(2)波狀齒心臟形 (Wavy Cordate)：葉緣鋸齒鈍，呈波狀形。

(3)齒牙狀心臟形 (Dentate Cordate)：葉緣鋸齒尖銳，由中心向外方放射之方向生出。

(4)粗鋸齒心臟形 (Roughly Serrate Cordate)：葉緣鋸齒粗，而間隔不一律。

(5)腎形 (Reni form)：葉身寬闊，基部凹入內方，先端鈍圓，全體爲腎狀形。

(6)波狀齒腎臟形 (Wavy Reni form)：葉緣鋸齒鈍，呈波狀形。

(7)齒牙狀腎臟形 (Dentate Reni form)：葉緣鋸齒尖銳，由中心向外方放射之方向生出。

(8)粗鋸齒腎臟形 (Roughly Serrate Reni form)：葉緣鋸齒粗，而間隔不一律。

(9)鼻形 (Nose like)：葉身長先端尖銳，中部兩側向內方陷入，似鼻。

(10)波狀齒鼻形 (Wavy Nose like)：葉緣鋸齒鈍，呈波狀形。

(11)齒牙狀鼻形 (Dentate Nose like)：葉緣鋸齒尖銳，由中心向外方放射之方向生出。

(12)粗鋸齒鼻形 (Roughly Serrate Nose like)：葉緣鋸齒粗，而間隔不一律。

(13)戟形 (Hastate)：葉身長基部凹入內方，葉身下部兩側之先端尖銳，兩先端至頂端爲直線延伸。

(14)波狀齒戟形 (Wavy Hastate)：葉緣鋸齒鈍，呈波狀形。

(15)齒牙狀戟形 (Dentate Hastate)：葉緣鋸齒尖銳，由中心向外方放射之方向生出。

(16)粗鋸齒戟形 (Roughly Serrate Hastate)：葉緣鋸齒粗，而間隔不一律。

(17)三淺裂葉 (Tri-Cleft incition)：葉緣至主脈分裂，不超過 1/2 ，葉身分裂爲三缺刻。

(18)三深裂葉 (Tri-Parted incition)：葉緣至主脈分裂，超過 1/2 以上，葉身分裂爲三缺刻。

(19)五淺裂葉 (Penta-Cleft incition)：葉緣至主脈分裂，不超過 1/2 ，葉身分裂爲五缺刻。

(20)五深裂葉 (Penta-parted incition)：葉緣至主脈分裂，超過 1/2 以上葉身，分裂爲五缺刻。

2. 葉面積 (Leaf area)：

頂葉以下第六葉起至第十五葉止，以面積儀 (Planimeter) 測出十片葉之面積，而求得一平均值，按如下之等級歸類之：

極小(49.9以下)，小(50—79.9)，中(80—109.9)，大(110—139.9)，極大(140以上)。單位爲Cm^2。

3. 葉色 (Leaf color)：

a. 頂葉色：(Color of top-leaves)

以觀察按下列綠，周緣淡紫，周緣深紫，全淡紫，全紫，全深紫等六級類別之。

b. 葉脈色：(Color of leaf vein)

以觀察按如下綠，淡紫，深紫等三級類別之。

c. 葉基點色：(Color of leaf base)

以觀察按下列綠，淡紫，紫，深紫等四級類別之。

4. 葉柄毛：(Hair on petiole)

以觀察按下列之標準無，少，中，多等四級類別之。

B. 莖 (Stem)

1. 莖長：(Length of stem)

甘藷揷植後，生長六個月，選擇每株中最長之一，由基部起至頂端開展之葉止，測出十株莖長，求其平均值類別之。其標準如下：極短（109cm. 以下），短（110—239cm.），中(240—369cm.)，長(370—499cm.)，極長（500cm. 以上)。

2. 莖直莖：(Diameter of stem)

利用測莖長之材料，于頂葉下全長 1/3 處測出十株之直徑，求其平均值類別之。其標準如下：細(.19cm. 以下)，中(.20—.49cm.)，粗(.50cm. 以上)。

3. 節間距離：(Length of internode)

利用測莖長之材料，由頂葉起至基部止，調查其節數，以節數除莖長所得之商，求十株之平均值類別之。其標準如下：短(3.4cm. 以下)，中(3.5—5.9cm.)，長(6.0cm. 以上)。

4. 分枝數：(Number of branches)

利用前項材料之植株，將全株凡 2cm. 以上之分枝全數數之，求其十株之平均值類別之。其標準如下：少(10以下)，中(11—25)，多(26以上)。

5. 生長習性(Growing habit)

以目觀察按下列直立，半直立，匍匐，纒繞等四級類別之。

6. 莖色：(Color of stem)

以目觀察按下列綠，綠褐，淡紫，紫，深紫等五級類別之。

7. 莖毛：(Hair on stem)

以觀察按下列目標準無，少，中，多等四級類別之。

C. 塊根(一) (Tuber(1))

1. 塊根形狀(Tuber form)

甘藷揷植後，經生長六個月，收穫十株塊根，在十株塊根中，選擇具有代表其品種性狀者（卽與全個數中之大部分類似者）兩個，分別測出其縱徑與橫徑比率之平均係數類別之。

將塊根首尾之殘餘部分切除，縱切為二等分，測其縱徑(長度)，再將此二等分之一，由首至尾，在其全長1/4，2/4，3/4處，橫測其三處之直徑，以其中最大之橫徑除縱徑，卽得一係數，然後求出兩個塊根之平均係數，按以下之分類標準類別。

塊根形狀名稱	分類標準
(1)長紡錘形 (Long Spindle)	縱徑/最大橫徑=3.0 以上
(2)上膨長紡錘形 (Obovate Long Spindle)	〃 =3.0 以上
(3)下膨長紡錘形 (Pear Shaped Long spindle)	〃 =3.0 以上
(4)紡錘形 (Spindle)	〃 =2.0 以上
(5)上膨紡錘形 (Obovate Spindle)	〃 =2.0 以上
(6)下膨紡錘形 (Pear Shaped Spindle)	〃 =2.0 以上
(7)短紡錘形 (Short Spindle)	〃 =1.5 以上
(8)上膨短紡錘形 (Obovate Short Spindle)	〃 =1.5 以上
(9)下膨短紡錘形 (Pear Shaped Short Spindle)	〃 =1.5 以上
(10)圓筒形 (Cylindrical form)	肩中基各部直徑相同
(11)球形 (Sphere)	〃 =1.4 以下
(12)塊瘤形 (Irregular globulous form)	凹凸不整者

紡錘形：長短不拘，2/4 處之橫徑較其他二處之橫徑大者。

上膨： 1/4 處之橫徑較其他二處之橫徑大者。

下膨： 3/4 處之橫徑較其他二處之橫徑大者。

2. 外皮粗滑 (Texture of skin)

以手之觸覺按下列粗，中，滑三類區別之。

3. 外皮纖維 (Fiber containing in skin)

觀察其表皮內纖維(維管束)之有無與明顯度，按下列無，明顯，不明顯等三類區別之。

4. 皮色 (Color of skin)

利用前項收穫之材料，選擇塊根一個，洗滌乾後，對照 Ridgway-Color Standards and Nomenclature 之圖色，按其色之組成比率及該色之濃淡比率，直譯出其所屬色名，兹將 Ridgway 氏所著該書顏色之配合比率及色調之配合比率摘述於下，並按其比率譯定稱謂於側以玆參考。

顏 色 配 合 比 率 表

(Table of percentage of Component Colors in the)
Connecting hues of the Chromatic scale

顏色簡稱 Color	顏色配合比率 (%) Percentage of Connecting Hues		稱 謂
	Red	Violet	
Violet	0	100	
VR—V	7	93	帶赤紫
R—V	18	82	帶赤紫
RR—V	33	67	赤紫
V—R	52	48	紫赤
RV—R	74	26	帶紫赤
V—RR	90	10	帶紫赤
Red	100	0	

色調配合比率表

(Table Showing percentage of white and Black, or Luminocity scales.)

色調符稱 Tone	百分率 (%) Percentages			稱謂
	白 White	色 Color	黑 Black	
(White)	100	0		
f	45	55	—	淡　淡
d	22.5	77.5	—	淡
b	9.5	90.5	—	淡
(Full Color)	—	100	—	
i	—	55	45	濃
k	—	29.5	70.5	濃
m	—	12.5	87.5	暗
(Black)		0	100	

5. 肉色 (Color of flesh)

將調查皮色之材料橫切，根據 Ridgway-Color Standards and Nomenclature 之圖色，以定其橫切面之肉色。

6. 斑暈色 (Tinged color in the color of flesh)

觀察前項材料之肉色，檢視其斑暈色按以下標準無，白，黃，淡橙黃，淡橙紅，橙江，淡紫，紫等八類類別之。

D. 塊根(二) (Tuber (2))

1. 成熟期 (Maturing period)

關於甘藷之成熟期，溫帶地方，概以秋末降霜以前，莖葉呈現枯黃爲其收穫適期；臺灣位於熱帶與亞熱帶之間，終年氣候溫暖，甘藷插植後生長經六個月以上，或即使爲早熟品種，其莖葉之生長，仍繼續不停，若以莖葉生長之情形，判斷其成熟期，當至爲困難；非釐定一適當標準，不足以探悉其早熟或晚熟。

本調查所採用之標準，以甘藷插植後經生長六個月之塊根收量爲指數 (100)，與經生長四個月，五個月及七個月之塊根收量比較，同時再按其合于標準重量之個數佔總個數比率幾何，而決定其成熟期。其分類標準如下：

		以六個月收量爲指數 (100)	單個重量 (標準重量)	總個數與標準重量之個數比率%
早生種	四個月	70以上	120g.以上	50以上
	五個月	95以上	150g.以上	50以上
晚生種	四個月	30以下	50g.以下	50以上
	五個月	50以下	70g.以下	50以上

中生種 {在二者之間者 (1)中早—近於早生之中生種
(2)中晤—近於晚生之中生種

調査株數每品種每期各十株

2. 塊根大小 (Tuber size)

甘藷挿植後，經生長達六個月，將十株之塊根個數，凡十公分重以上者，切除首尾兩端，而逐一測其重量，求平均値，按以下：

極小(79g.以下)，小(80—159)，中(160—239)，大(240—319)，極大(320g.以上)等五級類別之。

3. 肉質 (Quality)

收穫後，將塊根三個洗滌蒸熟，冷却之，觀察其横斷面，並以舌觸之，根據其澱粉粒之多少，水分之含量，緻密程度，而分別之，其標準如下：粉質，粘質，中間質三類。

4. 食味 (Taste)

利用前項蒸熟之塊根品嚐而類別之；其標準如下。上上，上中，上下，中上，中中，中下，下上，下中，下下等九類。

5. 塊根個數—十株平均 (Number of tubers-average of ten plants)

甘藷挿植後經生長六個月，調査十株塊根之每株平均個數而類別之。其標準如下：極少 (1.0個以下)，少(1.1—2.0)，中(2.1—3.0)，多(3.1—4.0)，極多(4.1以上)等五級。

6. 製簽率 (Percentage of chips)

利用前項收穫之塊根。選擇中等大而完整之塊根三個，洗滌晒乾後，切除首尾，秤量 500公分，用菜擦擦爲絲，置入亜鉛乾燥盤內，晒乾分二回秤量其乾物量，第一回在曝晒第二日後秤之，第二回在曝晒第三日後秤之，以其最小重量之一，算出乾物量之百分率，即爲其製簽率，按製簽率之高低類別之，其標準如下：極少(20.9%以下)，少(21—25.9)，中(26—30.9)，多(31—35.9)，極多 (36%以上) 等五級。

7. 塊根收量 (Yield of tubers)

利用前項收穫(經生長達六個月)之塊根，調査十株塊根之每株平均產量，而評定其等級。標準如下：極少(99公分以下)，少(100—399)，中(400—699)，多(700—999)，極多 (1000公分以上) 等五級。

8. 莖葉收量 (Yields of stems and leaves)

利用前項收穫上部莖葉之每株平均收量，而類別之。其標準如下：極少 (199公分以下)，少(200—399)，中(400—599)，多(600—799)，極多(800公分以上)等五級。

E. 花 (Flower)

1. 開花期及開花數 (Duration of flowering season and number of flowers)

甘藷挿植後，由開始開花起，到開花完畢止，調査十株之開花數，而求出每株之平均開花數類別之；並記載其花期範圍。其分類標準如下：不開花者，極少(9個以下)，少 (10—39)，中(40—69)，多(70—99)，極多(100個)以上等六級。

(五) 甘藷引進品種特性觀察結果

甘藷引進品種特性觀察結果按葉、莖、塊根(一)、塊根(二)及花五類列表於下：

表一　葉

Table I.　Leaf

品種名稱 Variety	葉形 Leaf form	葉面積 Leaf area 大小 Size(cm^2)	葉面積 Leaf area 分級 Grade	葉色 Leaf Color 頂葉色 Color of top-leaves	葉色 Leaf Color 葉基點色 Color of leaf base	葉色 Leaf Color 葉脈色 Color of leaf vein	葉柄毛 Hair on petiole
Nancy Hall (南瑞薯)	心臟形	98.3	中	綠	深紫	深紫	無
Porto Rico (普利)	戟形	86.3	〃	周緣淡紫	深紫	綠	〃
Sp 4——4	心臟形	68.8	小	全紫	淡紫	〃	少
洋薯	戟形	40.8	極小	綠	深紫	深紫	無
合川大藤子	戟形粗鋸齒	64.1	小	〃	〃	〃 〃	少
風吹底	五淺裂葉	26.5	極小	全淡紫	紫	淡紫	〃
假英國種	三淺裂葉	54.9	小	綠	淡深	綠	無
連城齒老種	五深裂	39.6	極小	全淡紫	〃 〃	〃	少
連城五齒老種	五深裂葉	38.7	〃 〃	〃 〃 〃	〃 〃	〃	少
臺灣白	三淺裂葉	32.9	〃 〃	全深紫	深紫	深紫	〃
蕃仔薯	戟形粗鋸齒	32.1	〃 〃	全紫	淡紫	綠	無
永春五齒	五深裂葉	54.4	小	〃 〃	〃 〃	〃	少
白尾白	戟形	26.5	極小	綠	綠	綠	無
紅心粒	三深裂葉	39.2	〃 〃	〃	淡紫	〃	多
紅尾白	戟形	30.3	〃 〃	〃	綠	〃	無
蛋黃紅	心臟形粗鋸齒	27.1	〃 〃	全淡紫	淡紫	淡紫	少
黃藷	三淺裂葉	40.7	〃 〃	綠	〃 〃	綠	〃
蕃茹芋	戟形	86.8	中	周緣淡紫	深紫	深紫	無
寶圓売	三深裂葉	64.3	小	綠	淡紫	綠	少
六十日藷	三深裂葉	55.2	〃	〃	〃 〃	〃	〃
紅皮藷	五淺裂葉	36.3	極小	全紫	〃 〃	綠	無
松陽(23)	三深裂葉	48.6	〃 〃	綠	綠	〃	少
〃 〃 (41)	〃 〃 〃 〃	52.6	小	〃	淡紫	〃	〃
〃 〃 (208)	〃 〃 〃 〃	53.4	〃	〃	綠	綠	〃
〃 〃 (243)	〃 〃 〃 〃	59.9	〃	〃	淡紫	綠	〃
嶺南一	五深裂葉	44.1	極小	〃	深紫	深紫	無
〃 〃 二	五深裂葉	53.1	小	〃	〃 〃	深紫	〃
〃 〃 四	三淺裂葉	29.0	極小	全紫	淡紫	綠	〃
〃 〃 五	三深裂葉	52.3	小	綠	淡紫	〃	多
〃 〃 六	五淺裂葉	30.5	極小	全紫	紫	〃	無
嶺 No. 1	三深裂葉	55.0	小	綠	淡紫	綠	〃
〃 No. 6	戟形	84.5	中	〃	深紫	〃 〃	〃
〃 No. 16	五深裂葉	67.4	小	全淡紫	綠	綠	〃
〃 No. 24	五深裂葉	81.1	中	綠	深紫	深紫	多
〃 No. 36	三淺裂葉	48.1	標小	全深紫	深紫	〃 〃	無
〃 No. 37	三淺裂葉	67.1	小	綠	〃 〃	綠	少
四川種 2	三淺裂葉	67.4	〃	周緣淡紫	深紫	深紫	無

〃 〃 〃 3	五深裂葉	37.4	極小	綠	深紫	綠	〃
〃 〃 〃 10	三淺裂葉	39.6	〃 〃	綠	綠	〃	〃
〃 〃 〃 36	三深裂葉	55.4	小	周緣淡紫	淡紫	〃	〃
〃 〃 〃 39	心臟形	54.2	〃	全淡紫	綠	〃	〃
〃 〃 〃 47	鼻形	53.1	〃	周緣淡紫	深紫	淡紫	〃
Red Nancy	心臟形	66.1	〃	綠	紫	綠	〃
Oklahoma (24)	心臟形	68.0	〃	〃	淡紫	綠	少
沖繩 100 (一)	三淺裂葉	58.4	〃	〃	〃 〃	〃	少
沖繩 100 (二)	五深裂葉	39.0	極小	綠	紫	紫	多
連城新種 (一)	五深裂葉	23.7	〃 〃	全淡紫	淡紫	綠	少
〃 〃 〃 〃 (二)	〃 〃 〃 〃	33.6	〃 〃	〃 〃 〃	〃 〃	〃	少
沖川種	〃 〃 〃 〃	28.2	〃 〃	〃 〃 〃	〃 〃	〃	〃
永安閩農試場種(一)	〃 〃 〃 〃	24.5	〃 〃	〃 〃 〃	〃 〃	〃	〃
〃 (二)	〃 〃 〃 〃	27.9	〃 〃	〃 〃 〃	淡紫	〃	〃
紅尾種	三淺裂葉	24.5	〃 〃	全深紫	深紫	深紫	〃
臺灣二號	五深裂葉	39.5	〃 〃	全淡紫	淡紫	綠	〃
芬薯	鼻形	45.4	〃 〃	綠	深紫	淡紫	無
七十二日種(一)	五深裂形	27.3	〃 〃	全淡紫	淡紫	綠	少
〃 (二)	〃 〃 〃 〃	30.5	〃 〃	〃 〃 〃	〃 〃	〃	少
六十日早	〃 〃 〃 〃	29.3	〃 〃	〃 〃 〃	〃 〃	〃	〃
閩農試場金瓜	〃 〃 〃 〃	28.1	〃 〃	〃 〃 〃	〃 〃	〃	〃
Nancy Hall (南瑞苕)	心臟形	97.0	中	綠	深紫	深紫	無
四川種 4	三深裂葉	48.1	極小	全紫	〃 〃	〃 〃	少
〃 〃 〃 19	三淺裂葉	27.5	〃 〃	全深紫	〃 〃	淡紫	無
〃 〃 〃 20	戟形	54.3	小	周緣淡紫	〃 〃	深紫	〃
〃 〃 〃 21	戟形粗鋸齒	40.7	極小	〃 〃 〃 〃	紫	綠	〃
〃 〃 〃 24	五深裂葉	36.0	〃 〃	全淡紫	深紫	淡紫	〃
〃 〃 〃 26	心臟形	45.8	〃 〃	全紫	〃 〃	深紫	少
〃 〃 〃 27	三深裂葉	13.6	〃 〃	周緣淡紫	綠	綠	無
〃 〃 〃 33	三淺裂葉	39.4	〃 〃	全淡紫	綠	〃	〃
〃 〃 〃 34	五深裂葉	22.5	〃 〃	綠	深紫	淡紫	〃
〃 〃 〃 35	三淺裂葉	72.9	小	周緣淡紫	綠	綠	〃
〃 〃 〃 38	三深裂紫	30.5	極小	〃 〃 〃 〃	深紫	〃	〃
〃 〃 〃 40	三深裂葉	40.1	〃 〃	〃 〃 〃 〃	〃 〃	深紫	〃

表二 莖

Table II Stem

品種名稱 Variety	莖長 Length of stem		莖直徑 Diameter of stem		節間距離 Length of internod		分枝數 Number of branches		生長習性 Growing habit	莖色 Color of stem	莖毛 Hair on stem
	長度 Lengths (cm.)	分級 Grade	直徑 Diameter (cm.)	分級 Grade	長度 Lengths (cm.)	分級 Grade	枝數 Numbers	分級 Grade			
Nancy Hall (南瑞苕)	80.0	極短	0.59	粗	1.77	短	8	少	匍匐	綠	多
Porto Rico (普利)	83.0	〃 〃	0.41	中	2.93	〃	8	〃	〃 〃	紫	〃

Sp 4 ——— 4	246.2	中	0.51	粗	3.51	中	12	中	〃 〃	淡紫	中
洋 苕	205.7	短	0.41	中	4.18	〃	18	〃	〃 〃	〃〃	無
合川大藤子	54.5	極短	0.45	〃	1.49	短	9	少	直 立	綠	多
風 吹 底	181.5	短	0.31	〃	3.08	〃	19	中	匍 匐	紫	中
假英國種	124.1	〃	0.49	〃	2.48	〃	15	〃	半直立	綠	無
連城齒老種	207.6	〃	0.41	〃	3.03	〃	12	〃	匍 匐	綠褐	中
連城五齒老種	192.2	〃	0.42	〃	29.5	〃	14	〃	〃 〃	〃〃	〃
臺 灣 白	170.9	〃	0.37	〃	2.94	〃	26	多	〃 〃	淡紫	無
蕃 仔 薯	137.2	〃	0.33	〃	2.91	〃	18	中	〃 〃	綠	〃
永 春 五 齒	81.2	極短	0.44	〃	2.30	〃	10	〃	直 立	紫	多
白 尾 白	84.1	〃〃	0.32	〃	2.18	〃	17	〃	匍 匐	綠	無
紅 心 粒	148.8	短	0.39	〃	3.24	〃	15	〃	〃 〃	綠褐	少
紅 尾 白	138.0	〃	0.32	〃	2.96	〃	21	〃	〃 〃	綠	無
蛋 黃 紅	184.3	〃	0.38	〃	2.48	〃	16	〃	〃 〃	綠褐	中
黃 藷	160.3	〃	0.38	〃	3.41	〃	15	〃	〃 〃	〃〃	少
蕃 茹 芋	123.4	〃	0.52	粗	2.78	〃	12	〃	半直立	深紫	〃
寶 圓 亮	195.4	〃	0.42	中	4.06	中	14	〃	匍 匐	綠	〃
六 十 日 藷	123.6	〃	0.40	〃	2.93	短	9	少	〃 〃	〃	中
紅 皮 ・藷	181.5	〃	0.35	〃	4.10	中	25	中	〃 〃	紫	〃
松 陽 (23)	291.0	中	0.39	〃	4.59	〃	15	〃	〃 〃	綠褐	多
〃 〃 (41)	189.8	短	0.42	〃	3.65	〃	10	〃	〃 〃	〃〃	少
〃 〃 (208)	250.2	中	0.39	〃	4.58	〃	13	〃	〃 〃	〃〃	多
〃 〃 (243)	188.5	短	0.39	〃	3.56	〃	9	少	〃 〃	〃〃	少
嶺 南 一	129.1	〃	0.42	〃	3.06	短	34	多	半直立	紫	無
〃 〃 二	84.9	極短	0.39	〃	1.99	〃	9	少	〃〃〃	淡紫	〃
〃 〃 四	151.4	短	0.29	〃	3.08	〃	24	中	匍 匐	〃〃	〃
〃 〃 五	208.8	〃	0.40	〃	3.81	中	17	〃	〃 〃	綠褐	多
〃 〃 六	152.2	〃	0.33	〃	3.79	〃	16	〃	〃 〃	紫	〃
嶺 No. 1	171.8	〃	0,43	〃	3.15	短	9	少	〃 〃	綠褐	少
〃 No. 6	232.5	〃	0.49	〃	3.74	中	16	中	半直立	深紫	〃
〃 No. 16	220.2	〃	0.43	〃	3.75	〃	22	〃	匍 匐	綠	中
〃 No. 24	170.1	〃	0.56	粗	3.10	短	6	少	〃 〃	紫	多
〃 No. 36	345.7	中	0.43	中	4.31	中	31	多	〃 〃	淡紫	少
〃 No. 37	126.4	短	0.48	〃	2.79	短	7	少	〃 〃	〃〃	〃
四 川 種 2	168.0	〃	0.53	粗	3.32	〃	9	〃	半直立	〃〃	無
〃 〃 〃 3	250.2	中	0.39	中	4.41	中	22	中	匍 匐	綠	中
〃 〃 〃 10	165.9	短	0.31	〃	4.49	〃	11	〃	纏 繞	〃	少
〃 〃 〃 36	125.4	〃	0.41	〃	3.26	短	6	少	匍 匐	紫	多
〃 〃 〃 39	116.1	〃	0.45	〃	2.39	〃	25	中	直 立	淡紫	無
〃 〃 〃 47	131.5	〃	0.44	〃	2.45	〃	20	〃	〃 〃	深紫	〃
Red Nancy	57.6	極短	0.60	粗	1.61	〃	6	少	半直立	綠	中
Oklahoma (24)	67.4	極短	0.53	粗	1.96	〃	7	少	匍 匐	紫	中
冲繩 100 (一)	70.2	〃	0.50	中	2.11	〃	13	中	半直立	淡紫綠	〃

冲繩 100 (二)	163.9	短	0.46	〃	2.72	短	23	〃	〃〃〃	紫	多
連城新種 (一)	121.8	〃	0.27	〃	2.59	〃	19	〃	匍匐	綠褐	中
連城新種 (二)	141.5	〃	0.30	〃	2.80	〃	19	〃	〃〃	〃〃	〃
冲川種	134.0	〃	0.29	〃	2.49	〃	21	〃	〃〃	〃〃	少
永安閩農試場種 (一)	121.0	〃	0.28	〃	2.29	〃	18	〃	〃〃	〃〃	〃
〃 (二)	150.3	〃	0.29	〃	2.79	〃	15	〃	〃〃	〃〃	〃
紅尾種	126.0	〃	0.31	〃	3.07	〃	36	多	〃〃	淡紫	無
臺灣二號	168.0	〃	0.31	〃	2.68	〃	14	中	〃〃	綠褐	少
芬薯	191.0	〃	0.36	〃	3.77	〃	25	〃	〃〃	綠	無
七十二日種 (一)	131.0	〃	0.28	〃	2.16	〃	17	〃	〃〃	綠褐	中
〃 (二)	135.0	〃	0.29	〃	2.37	〃	18	〃	〃〃	〃〃	少
六十日早	121.0	〃	0.32	〃	2.61	〃	15	〃	〃〃	〃〃	〃
閩農試場金瓜	101.0	極短	0.30	〃	2.18	〃	15	〃	〃〃	〃〃	〃
南瑞苕	69.8	〃〃	0.49	〃	1.78	〃	5	少	〃〃	綠	多
四川種 4	201.0	短	0.31	〃	5.76	中	13	中	〃〃	淡紫	〃
〃 〃 〃 19	104.0	極短	0.24	〃	2.97	短	20	〃	〃〃	紫	無
〃 〃 〃 20	80.5	〃〃	0.38	〃	2.22	〃	22	〃	半直立	深紫	中
〃 〃 〃 21	78.6	〃〃	0.30	〃	1.92	〃	17	〃	〃〃〃	淡紫	少
〃 〃 〃 24	63.1	〃〃	0.35	〃	1.72	〃	14	〃	直立	紫	中
〃 〃 〃 26	140.3	短	0.25	〃	3.56	中	8	少	匍匐	深紫	多
〃 〃 〃 27	46.4	極短	0.22	〃	1.41	短	12	中	直立	淡紫	無
〃 〃 〃 33	183.2	短	0.35	〃	3.18	〃	21	〃	匍匐	綠	少
〃 〃 〃 34	73.5	極短	0.32	〃	1.75	〃	36	多	直立	紫	〃
〃 〃 〃 35	73.1	〃〃	0.32	〃	2.18	〃	6	少	〃〃	淡紫	無
〃 〃 〃 38	119.3	短	0.42	〃	3.23	〃	33	多	〃〃	〃〃	〃
〃 〃 〃 40	68.6	極短	0.34	中	1.81	〃	18	中	〃〃	深紫	少

表三　塊　根（一）

Table Ⅲ.　Tuber (1)

品種名稱 Variety	塊根縱徑 Longitudinal diameter of tuber (cm)—A	塊根橫徑 Transvers diameter of tuber (cm)—B 1/4*	2/4	3/4**	塊根形狀 Tuber form 縱徑/最大橫徑 A/Large of B	稱謂 Name	外皮粗滑 Texture of skin	外皮纖維 Fiber containing in skin	皮色 Color of skin		肉色 Color of flesh		斑暈色 Tinged color in the color of flesh
Nancy Hall (南瑞苕)	14.03	4.72	5.86	4.92	2.39	紡錘形	粗	無	Vinaceous Cinnamon	淡帶黃橙	Light Salmon orange	淡橙	橙紅
Porto Rico (普利)	12.48	4.38	5.33	4.49	2.34	〃	中	〃	Testaceus	帶赤橙	Flesh Ocher	淡帶赤橙	無
SP 4——4	17.25	3.74	4.52	4.83	3.57	下膨長紡錘形	滑	不明顯	Vinaceous Purple	濃紫赤	Cream Color	淡淡橙黃	〃
洋苕	15.05	4.45	6.06	5.76	2.48	紡錘形	〃	〃	Cream Color	淡淡橙黃	White	白	〃
合川大藤子	17.03	3.41	4.81	5.62	3.03	下膨長紡錘形	中	〃	Vinaceous Pink	淡帶赤橙	Cream Color	淡淡橙黃	淡紫
風吹底	15.20	3.94	5.35	5.92	2.57	下膨紡錘形	〃	無	Vinaceous Cinnamon	淡帶黃橙	Salmon Color	淡帶赤橙	無
假英國種	14.85	4.15	5.42	4.78	2.74	紡錘形	滑	不明顯	Rocellin purple	淡帶紫赤	White	白	〃
連城齒老種	16.65	5.12	6.02	5.80	2.76	〃	〃	無	Vinaceous purple	濃紫赤	White	白	〃
連城五齒老種	15.63	5.32	6.49	6.10	2.41	〃	〃	〃	〃	〃	White	白	〃
臺灣白	20.91	4.11	5.45	4.64	3.84	長紡錘形	中	不明顯	Light Cango Pink	淡赤橙	Iyory yellow	淡帶橙黃	〃
蕃仔薯	14.53	4.42	5.45	5.07	2.67	紡錘形	粗	〃	Buff Pink	淡橙	White	白	〃
永春五齒	13.92	4.08	5.37	5.25	2.59	〃	滑	〃	Cream Color	淡淡橙黃	Maize yellow	淡橙黃	〃
白尾白	16.08	4.00	5.61	5.40	2.87	〃	中	〃	Pinkish Buff	淡黃橙	White	白	〃
紅心粒	15.95	4.35	5.02	5.01	3.18	長紡錘形	〃	〃	Dark Vinaceous	赤	Cream Color	淡淡橙黃	〃

紅尾白	13.78	4.33	5.00	4.99	2.76	紡錘形	〃	〃	Light Pinkish Cinnamon	淡帶黃橙	White	白	〃
蛋黃紅	13.23	4.33	5.06	4.89	2.61	〃	滑	無	Cream Color	淡淡橙黃	Cream Color	淡淡橙黃	淡橙黃
黃藷	17.17	3.85	5.34	6.14	2.79	下膨紡錘形	中	不明顯	Light Vinaceous Cinnamon	淡帶黃橙	Cream Color	淡淡橙黃	無
蕃茄芋	16.07	5.24	6.90	6.32	2.33	紡錘形	〃	明顯	Dark Vinaceous Purple	濃紫赤	White	白	紫
寶圓売	17.84	4.08	5.05	6.15	2.90	下膨紡錘形	〃	不明顯	Light Cango Pink	淡橙赤	Cream Coror	淡淡橙黃	淡橙黃
六十日藷	18.73	4.62	5.95	6.02	3.11	下膨長紡錘形	〃	〃	Hellebore Red	帶紫赤	White	白	無
紅皮藷	15.89	4.51	5.16	5.00	3.08	長紡錘形	滑	〃	Light Corinthian Red	淡帶橙赤	Lvory yellow	淡淡帶橙黃	〃
松陽 (23)	16.30	4.85	5.85	7.00	2.76	下膨紡錘形	中	〃	Dark Vinaceous	赤	Cream Color	淡淡橙黃	淡橙黃
〃 (41)	16.69	3.62	4.94	5.20	3.21	下膨長紡錘形	滑	〃	Russet Vinaceous	帶赤橙	White	白	無
〃 (208)	20.12	4.43	4.63	6.17	3.26	下膨長 〃	中	〃	Dark Vinaceous	赤	Cream Color	淡淡橙黃	淡橙黃
〃 (243)	20.92	4.17	5.43	5.88	3.56	下膨長 〃	滑	〃	Russet Vinaceous	帶赤橙	White	白	無
嶺南一	16.37	4.14	5.20	4.58	3.15	長紡錘形	中	明顯	Cream Color	淡淡橙黃	White	白	紫
〃 二	13.40	6.31	7.44	6.35	1.80	短紡錘形	滑	不明顯	Cinnamon Rufous	濃橙	Mulberry purple	濃帶赤紫	白
〃 四	16.90	4.72	5.74	5.07	2.94	紡錘形	粗	〃	Vinaceous Pink	淡帶赤橙	White	白	無
〃 五	16.54	4.65	5.67	6.38	2.59	下膨紡錘形	滑	〃	Dark Vinaceous	赤	Cream Color	淡淡橙黃	淡橙黃
〃 六	16.64	4.12	4.89	4.56	3.40	長紡錘形	滑	無	Light Russet Vinaceous	淡帶赤橙	Naphthalone yellow	淡淡黃	無
嶺 No. 1	23.62	4.73	6.00	5.70	3.94	〃	中	不明顯	Hydrangea Red	濃赤	White	白	〃
〃 No. 6	16.02	5.52	7.17	6.51	2.23	紡錘形	中	明顯	Dark Livid Brown	濃赤	Waite	白	紫
〃 No. 16	18.31	4.12	5.72	5.87	3.12	下膨長紡錘形	滑	〃	Light Buff	淡淡黃橙	White	白	淡橙黃

〃 No. 24	14.83	4.02	5.83	4.98	2.54	紡錘形	中	〃	Prussian Red	濃橙赤	Pale Orange yellow	淡淡黃橙	淡紅
〃 No. 36	21.45	4.16	5.49	5.57	3.85	下膨長紡錘形	滑	不明顯	Orange Vinaceous	淡橙赤	Ochraceous Salmon	淡帶黃橙	無
〃 No. 37	16.96	3.78	5.32	6.11	2.77	下膨紡錘形	〃	〃	Dahlia Carmine	濃帶紫赤	White	白	紫
四川種 2	17.28	4.05	4.87	5.15	3.35	下膨長紡錘形	〃	〃	Light Rinkish Cinnamon	淡帶黃橙	Cream Color	淡淡橙黃	淡橙紅
〃 3	16.82	4.72	5.75	4.89	2.92	紡錘形	〃	無	Capucine Buff	淡淡帶黃橙	Orange Buff	淡帶黃橙	紫
〃 10	18.90	3.76	4.26	4.15	4.43	長紡錘形	中	不明顯	Vinaceous Russet	濃赤橙	White	白	無
〃 36	14.10	3.10	4.02	2.92	3.51	〃	〃	明顯	Vinaceous purple	濃紫赤	Lvory yellow	淡淡帶橙黃	〃
〃 39	17.03	3.85	5.55	5.95	2.85	下膨紡錘形	〃	無	Mineral Red	濃赤	White	白	〃
〃 47	20.10	4.79	5.91	5.12	3.40	長紡錘形	粗	明顯	Vinaceous purple	濃紫赤	Lvory yellow	淡淡帶橙黃	〃
Red Nancy	10.90	3.11	4.44	3.80	2.45	紡錘形	滑	不明顯	Flesh Color	淡赤橙	Ochraceous Salmon	淡帶黃橙	〃
Oklahoma (24)	16.58	3.40	4.51	3.83	3.65	長紡錘形	粗	無	Cinnamon Rufous	濃橙	Bitter Sweet Orange	淡帶赤橙	〃
冲繩 100 (一)	13.83	4.89	5.86	5.30	2.36	紡錘形	滑	不明顯	Buff Pink	淡橙	Cream Color	淡淡橙黃	〃
冲繩 100 (二)	12.28	5.24	7.42	7.15	1.65	短紡錘形	中	明顯	Light Pinkish Cinnamon	淡帶黃橙	White	白	〃
連城新種(一)	13.13	4.50	4.95	5.05	2.60	下膨紡錘形	滑	無	Vinaceous purple	濃紫赤	〃	白	〃
〃 (二)	18.25	4.10	5.03	4.75	3.62	長紡錘形	〃	〃	〃	〃	〃	白	〃
冲川種	17.10	3.95	5.05	4.76	3.38	〃	〃	〃	〃	〃	〃	白	〃
永安閩農試場種(一)	15.50	3.70	4.85	5.68	2.72	下膨紡錘形	〃	〃	〃	〃	〃	〃	〃
〃 (二)	16,05	3,05	7.73	3.75	2.07	紡錘形	〃	無	〃	〃	〃	〃	〃
紅尾種	25.00	4.75	4.85	5.40	4.62	下膨長紡錘形	中	不明顯	Deep Vinaceous	淡赤	〃	〃	〃

臺灣二號	14.45	4.48	5.50	6.26	2.31	下膨紡錘形	滑	無	Vinaceous purple	濃紫赤	〃	〃	〃
芬 薯	16.40	4.90	5.05	4.98	3.24	長紡錘形	〃	明 顯	Cream Color	淡淡橙黃	〃	〃	〃
七十二日種(一)	14.83	4.43	6.33	6.25	2.34	紡錘形	〃	無	Vinaceous purple	濃紫赤	〃	〃	〃
七十二日種(二)	14.48	4.18	5.25	4.85	2.75	〃	〃	〃	〃	〃	〃	〃	〃
六十日早	13.45	4.45	4.75	5.08	2.64	下膨紡錘形	〃	〃	〃	〃	〃	〃	〃
閩農試場金瓜	13.10	4.63	5.41	4.43	2.42	紡錘形	〃	〃	〃	〃	〃	〃	〃
南 瑞 苕	10.75	5.35	6.63	5.01	1.62	短紡錘形	粗	無	Vinaceous Cinnamon	淡帶黃橙	Light Salmon orange	淡 橙	橙 紅
四 川 種 4	14.20	5.23	6.63	5.66	2.14	紡錘形	中	〃	Light Ochraceous Salmon	〃	Ochraceous Salmon	淡帶橙黃	紫
〃 19	15.50	4.10	5.80	6.18	2.51	下膨紡錘形	〃	不明顯	Pinkish Buff	淡黃橙	White	白	〃
〃 20	15.15	3.53	5.38	6.30	2.40	〃	滑	〃	Vernonia purple	濃帶紫赤	〃	〃	〃
〃 21	16.43	3.30	4.33	4.83	3.40	下膨長紡錘形	〃	〃	Hazel	濃 橙	Cartridge Buff	淡淡橙黃	無
〃 24	13.05	5.43	6.75	7.00	1.86	下膨短紡錘形	〃	明 顯	Cream Buff	淡橙黃	〃	〃	〃
〃 26	18.00	3.20	3.68	3.88	4.63	下膨長紡錘形	中	不明顯	Cinnamon Buff	淡黃橙	PolePinkish Buff	淡淡黃橙	〃
〃 27	14.10	2.73	3.75	4.00	3.52	〃	滑	〃	Livid Brown	赤	Cartridge Buff	淡淡橙黃	黃
〃 33	16.30	3.80	4.45	4.50	3.62	〃	粗	〃	Dark Vinaceous	赤	White	白	無
〃 34	16.68	5.13	5.50	6.00	2.78	下膨紡錘形	中	〃	Russet Vinaceous	帶赤橙	Lvory yellow	淡淡帶橙黃	〃
〃 35	14.25	3.13	3.55	2.95	4.01	長紡錘形	〃	〃	Cinnamon Buff	淡黃橙	Cartridge Buff	淡淡橙黃	〃
〃 38	14.75	4.45	5.68	3.60	2.59	紡錘形	粗	明 顯	Sorghum Brown	濃帶赤橙	Baryta yellow	淡淡帶橙黃	紫
〃 40	13.00	4.88	5.53	5.75	2.26	下膨紡錘形	中	不明顯	Chocolate	濃赤橙	Cartridge Buff	淡淡橙黃	無

* At one fourth part from the top of the tuber.

** At three fourth part from the top of the tuber.

表四 塊 根 (二)

Table IV. Tuber (2)

品種名稱 Variety	成熟期 Maturing period	單個平均重量 Averagd Wt. per tuber: 重量 Wt. (g)	分級 Grade	肉質 Quality	食味 Taste	塊根個數 Number of tubers (average of ten plants): 個數 Numbers	分級 Grade	製簽率 Percentage of chips: 百分率 %	分級 Grade	塊根收量 Yield of tubers (average of ten plants): 一株收量 Yield per plant (g)	分級 Grade	每公頃收量 Yield (kg/ha)	莖葉收量 Yields of stems and leaves (average of ten plants): 一株收量 Yield per plant (g)	分級 Gade
Nancy Hall (南瑞苕)	中早	84.6	小	粉	上中	6.8	極多	40.3	極多	558	中	16,740	163	極少
Porto Rico (普利)	中早	68.3	極小	粘	上上	5.0	〃	35.4	多	355	少	10,650	71	極少
Sp 4———4	中	64.5	〃	中	中中	6.6	〃	32.7	〃	459	中	13,770	166	極少
洋苕	中早	140.7	小	粘	中下	3.8	多	27.9	中	567	〃	17,010	127	〃
合川大籐子	中	103 7	〃	中	中下	3.7	〃	29.4	〃	413	〃	12,390	76	極少
風吹底	中早	123.7	〃	粘	中中	4.1	極多	26.8	〃	546	〃	16,380	117	極少
假英國種	中	129.2	〃	粉	中下	5.4	〃	36.5	極多	673	〃	20.190	224	少
連城齒老種	中早	158.7	〃	粘	中中	3.7	多	30.1	中	642	〃	19,260	156	極少
連城五齒老種	中早	173.9	中	〃	中中	3.9	〃	29.4	〃	681	〃	20,430	170	〃
臺灣白	中	115.3	小	中	中下	3.8	〃	31.3	多	478	〃	14,340	287	少
蕃仔薯	中	153.8	〃	中	下上	3.5	〃	28.5	中	536	〃	16.080	83	極少
永春五齒	中早	104.5	〃	粉	中上	4.1	極多	35.3	多	453	〃	13.590	61	〃
白尾白	中	126.1	〃	粘	下上	4.4	〃	25.0	少	611	〃	18,330	73	〃
紅心粒	中早	177.0	中	〃	下中	3.3	多	25.3	〃	622	〃	18,660	123	極少
紅尾白	中	114.6	小	〃	下上	3.8	〃	26.3	中	607	〃	18,210	111	〃
蛋黃紅	中	66.3	極小	中	下上	5.5	極多	27.2	〃	417	〃	12,510	145	〃
黃藷	中早	169.6	中	〃	下中	4.1	〃	24.7	少	736	多	22,080	108	〃
蕃茄芋	中早	253.7	大	粉	下上	2.9	中	30.2	中	753	〃	22,590	207	少
寶圓亮	中	181.9	中	粘	下上	3.7	多	26.8	〃	714	〃	21,420	153	極少

六十日諸	中早	155.0	小	〃	中下	4.2	極多	24.5	少	667	中	20,010	58	極少
紅皮諸	中	114.7	〃	中	下上	5.8	〃	26.8	中	716	多	21,480	173	極少
松陽 (23)	早	219.8	中	〃	下中	3.8	多	23.7	少	713	〃	21,390	187	〃
〃 (41)	〃	140.6	小	粘	下上	4.4	極多	23.2	〃	684	中	20,520	76	極少
〃 (208)	〃	189.6	中	中	下中	3.8	多	22.5	〃	708	多	21.240	140	極少
〃 (243)	〃	143.7	小	粘	下上	4.7	極多	25.0	〃	803	〃	24.090	85	極少
嶺南 一	中	107.2	〃	粉	中下	4.5	〃	40.2	極多	537	中	16,110	353	少
〃 二	早	160.0	中	〃	中上	3.5	多	38.7	〃	603	〃	18,090	113	極少
〃 四	〃	167.0	〃	中	中下	4.4	極多	25.4	少	792	多	23,760	128	〃
〃 五	〃	250.0	大	〃	中下	3.4	多	25.3	〃	878	〃	26,340	159	〃
〃 六	中	117.7	小	〃	中下	3.7	〃	30.1	中	458	中	13,740	41	極少
嶺 No. 1	早	221.8	中	〃	下上	4.1	極多	25.0	少	944	多	28,320	108	極少
No. 6	中	257.5	大	粉	下上	2.5	中	29.5	中	606	中	18,180	206	少
No. 16	〃	144.5	小	粘	下中	5.8	極多	22.7	少	949	多	28,470	324	〃
No. 24	中晩	73.7	極小	粉	中中	3.2	多	38.7	極多	271	少	8,130	236	〃
No. 36	中晩	185.6	中	中	下上	3.8	〃	23.1	少	771	多	23,130	379	〃
No. 37	中	128.7	小	〃	中下	4.1	極多	30.3	中	584	中	17,520	79	極少
四川種 2	〃	131.3	〃	粉	中中	3.3	多	35.5	多	471	〃	14,130	212	少
〃 3	〃	123.6	〃	〃	中中	4.4	極多	36.1	極多	583	〃	17,490	304	〃
〃 10	〃	73.2	極小	中	下上	4.1	〃	36.7	〃	369	少	11,070	58	極少
〃 36	中晩	64.1	〃	粉	下中	2.2	中	40.6	〃	164	〃	4,920	47	〃
〃 39	中	128.3	小	〃	中下	5.2	極多	37.3	〃	707	多	21,210	299	少
〃 47	中	138.3	小	〃	中下	3.1	多	34.2	多	466	中	13,980	345	〃
Red Nancy	中早	37.3	極小	粘	上中	6.9	極多	32.4	多	264	少	7,920	52	極少
Oklahoma (24)	中早	50.4	極小	粘	上下	7.0	極多	29.8	中	367	少	11.010	37	極少

冲繩 100 (一)	〃	95.7	小	粉	中中	6.8	〃	348	多	664	中	19,920	63	〃
冲繩 100 (二)	中	117.0	〃	〃	下上	6.1	〃	32.4	〃	749	多	22,470	258	少
連城新種(一)	〃	128.7	〃	粘	中中	2.7	中	33.8	〃	361	少	10,830	100	極少
連城新種(二)	〃	131.4	〃	〃	〃	2.7	〃	36.0	極多	396	〃	10.880	158	〃
冲川種	中晚	98.7	〃	〃	中上	3.4	多	312	多	359	〃	10,770	176	〃
永安閩農試場種(一)	中	113.4	〃	〃	中上	3.2	〃	318	多	394	〃	11,820	100	〃
〃 (二)	中	145.0	小	〃	中中	2.4	中	34.0	〃	358	〃	10,740	124	〃
紅尾種	一	194.1	中	粉	中下	2.9	〃	35.0	〃	596	中	17,880	366	少
臺灣二號	中晚	69.5	小	粘	中中	3.2	多	34.6	〃	328	少	9,840	118	極少
芬薯	〃	93.5	〃	〃	下上	5.1	極多	29.0	中	555	中	16,650	752	多
七十二日種(一)	中	187.0	中	〃	中上	2.2	中	31.4	多	423	〃	12,690	157	極少
〃 (二)	中	115.0	小	〃	中中	3.2	多	32.2	〃	372	少	11.160	95	〃
六十日早	中早	81.1	〃	〃	〃	3.7	〃	32.0	〃	316	〃	9,480	106	〃
閩農試場金瓜	中	131.0	〃	〃	〃	3.0	中	32.6	〃	350	〃	10,500	99	〃
南瑞苕	中早	77.4	極小	粉	上中	4.1	極多	42,4	極多	346	〃	10,380	164	〃
四川種 4	中	162.6	中	中	中中	2.6	中	31.0	多	415	中	12,450	216	少
〃 19	中早	191.8	〃	粉	〃	3.0	〃	27.3	中	502	〃	15,060	135	極少
〃 20	中	124.2	小	中	〃	2.7	〃	39.0	極多	362	少	10,860	233	少
〃 21	中早	60.8	極小	粉		2.8	〃	40.8	〃	205.5	〃	6,165	85	極少
〃 24	〃	130.2	小	中	〃	2.7	〃	30.0	中	387	〃	11,610	107	〃
〃 26	〃	76.5	極小	粉	〃	2.9	〃	39.0	極多	228	〃	6,840	47	〃
〃 27	中晚	40.5	〃	中	中下	2.7	〃	36.4	〃	116.5	〃	3,495	12	〃
〃 33	中	110.1	小	粉	中中	3.7	多	41.0	〃	435	中	13,050	234	少
〃 34	中	221.9	中	粘	下上	3.1	〃	24.6	少	701.5	多	21,045	265	〃
〃 35	一	48.8	極小	粉	下中	8	極少	35.0	多	38	極少	1,140	86	極少
〃 38	中早	83.4	小	〃	中下	1.8	少	33.0	多	146	少	4,380	490	中
〃 40	中晚	125.4	〃	中	中中	2.6	中	34.0	多	347	〃	10,410	77	極少

表五　花

Table V.　Flower

品種名稱 Variety	*花期範圍 Duration of flowering season 月　日	 月　日	平均開花者 Average flower number per plant 花數 Numbers	 分級 Grade
Nancy Hall (南瑞薯)	11. 30	3. 10	6.8	極少
Porto Rico (普利)	11. 23	同年12. 27	1.8	〃
Sp 4—4	11. 10	2. 28	34.6	少
洋薯	10. 21	1. 6	3.1	極少
合川大藤子	10. 19	1. 28	39.4	少
風吹底				
假英國種	11. 13	2. 14	47.0	中
連城齒老種	12. 7	3. 1	9.8	極少
連城五齒老種	11. 17	1. 10	2.6	〃
臺灣白	11. 1	1 13	84.9	多
蕃仔薯				
永春五齒	10. 27	1. 21	32.2	少
白尾白				
紅心粒	11. 2	1. 11	22.9	少
紅尾白				
蛋黃紅				
黃藷	10. 27	1. 10	18.6	少
蕃茄芋	11. 18	3. 20	20.6	〃
寶圓壳	10. 27	1. 14	30.0	〃
六十日藷	10. 24	1. 6	7.2	極少
紅皮藷				
松陽 (23)	11. 13	1. 10	9.7	極少
〃 (41)	11. 4	1. 8	5.2	〃
〃 (208)	11. 1	1. 8	11.8	少
〃 (243)	11. 19	1. 7	3.7	極少
嶺南一	11. 26	2. 6	5.7	〃
〃 二	10. 17	3. 1	57.7	中
〃 四				
〃 五	11. 5	1. 10	10.9	少
〃 六				
嶺 No. 1	10. 30	1. 8	12.0	少
No. 6	12. 4	2. 10	16.1	〃
No. 16	11. 17	1. 19	9.1	極少
No. 24	10. 15	1, 18	113.9	極多
No. 36	11. 29	1. 6	1.3	極少
No. 37	11. 2	1. 12	1.3	〃
四川種 2	10. 23	4. 14	244.2	極多

〃 3	11. 12——2. 9	18.7	少
〃 10	10. 22——4. 14	85.8	多
〃 36	10. 15——3. 8	197.7	極 多
〃 39	10. 22——1. 30	10.2	少
〃 47	11. 7——1. 16	11.9	少
Red Nancy			
Oklahoma (24)	11. 3——同年11. 24	2.1	極 少
冲繩 100 (一)	11. 12——同年11. 28	13.2	少
冲繩 100 (二)	11. 8——4. 5	69.4	中
連成新種(一)	10. 28——1. 4	53.4	中
〃 (二)	11. 11——2. 23	80.9	多
冲川種	11. 6——2. 9	44.0	中
永安閩農試場種(一)	11. 15——2. 8	75.5	多
〃 (二)	11. 12——2. 10	70.9	〃
紅尾種	11. 14——1. 5	59.1	中
臺灣二號	11. 6——1. 18	89.8	多
芬薯	11. 25——3. 22	0.6	極 少
七十二日種(一)	11, 28——2. 23	57.4	中
〃 (二)	11. 4——3. 19	84.2	多
六十日旱	11. 5——3. 19	60.8	中
閩農試場金瓜	11. 7——2. 9	62.8	中
南瑞薯	12. 8——1. 4	1.4	極 少
四川種 4	11. 4——同年12. 30	67.1	中
〃 19	10. 30——1. 7	38.5	少
〃 20	11. 4——1. 2	14.7	少
〃 21	11. 30——1. 9	3.8	極 少
〃 24	11. 6——1. 16	63.6	中
〃 26	11. 1——1. 5	11.5	少
〃 27			
〃 33	11. 15——同年12. 28	9.6	極 少
〃 34			
〃 35	11. 1——1. 24	187.4	極 多
〃 38	12. 11——1. 13	16.6	少
〃 40	11. 14——同年12. 20	0.8	極 少

* 甘藷花期範圍，適跨越二個年度，本表內記載開花始終之日期，Nancy Hall 以下至四川種47計四十二品種，爲調查三年之最大花期範圍；Red Nancy 以下至冲繩100號(二)計四品種爲調查二年之最大花期範圍；連城新種(一)以下至四川種40計二十五品種，爲僅調查一年之花期範圍。

(六) 甘藷引進品種檢索表

莖姿勢	葉形	頂葉色	葉基色	莖色	開花多少	塊根形	皮色	肉色	斑暈	品種名
匍匐	心臟形	綠	深紫	綠	極少	紡錘形	淡帶黃橙	淡橙	橙	……Nacuy hall
		〃	淡紫	紫	〃	長紡錘形	濃橙	淡帶赤橙	無	……Okla homa24
		全紫	〃	淡紫	少	下膨長紡	濃紫赤	淡橙黃	〃	……Sp 4——4
	粗鋸齒心臟形	全淡紫	〃	綠褐	無	紡錘形	淡橙黃	淡黃	〃	……蛋黃紅
	戟形	周緣淡紫	深紫	紫	極少	〃	帶赤橙	淡帶赤橙	〃	……Porto Rico
		綠	〃	淡紫	〃	〃	淡橙黃	白	〃	……洋莒
		〃	綠	綠	無	〃	淡黃橙	白	〃	……白尾白
		〃	〃	〃	〃	〃	淡帶黃橙	白	〃	……紅尾白
	粗鋸齒戟形	全紫	淡紫	〃	〃	〃	淡橙	白	〃	……蕃仔薯
	五深裂	全淡紫	〃	綠褐	少	〃	濃紫赤	白	〃	……連城齒老種
		〃	〃	〃	極少	〃	〃	白	〃	……連城五齒老種
		〃	綠	綠	〃	下膨長紡	淡黃橙	白	淡橙黃	……嶺 No. 16
		綠	深紫	紫	極多	紡錘形	濃橙赤	淡黃橙	淡紅	……嶺 No. 24
		〃	深紫	綠	少	〃	淡帶黃橙	〃	紫	……四川種3
	三深裂	〃	淡紫	綠褐	〃	長紡錘形	赤	淡橙黃	無	……紅心粒
		〃	〃	綠	中	下膨紡	淡橙赤	〃	淡黃	……寳圓壳
		〃	〃	〃	少	〃	帶紫赤	白	無	……六十日諸
		〃	綠	綠褐	〃	〃	赤	淡淡橙黃	淡橙黃	……松陽23
		〃	淡紫	〃	極少	下膨長紡	帶赤橙	白	無	……松陽41
		〃	綠	〃	少	下膨紡	赤	淡淡橙黃	淡橙黃	……松陽208
		〃	淡紫	〃	極少	下膨長紡	帶赤橙	白	無	……松陽243
		〃	〃	〃	少	下膨紡	赤	淡淡橙黃	淡橙黃	……嶺南五
		周緣淡紫	〃	紫	極多	長紡錘形	濃紫赤	淡帶橙黃	無	……四川種36
		綠	〃	綠褐	少	〃	濃赤	白	〃	……嶺 No. 1
	五淺裂	全深紫	紫	紫	無	下膨紡	淡帶黃橙	淡帶赤橙	〃	……風吹底
		全紫	淡紫	〃	〃	長紡錘形	淡帶橙赤	淡帶橙黃	〃	……紅皮諸
		〃	紫	〃	〃	〃	淡帶赤橙	淡淡黃	〃	……嶺南六
	三淺裂	全深紫	深紫	淡紫	多	〃	淡赤橙	白	〃	……臺灣白
		綠	淡紫	綠褐	少	下膨紡	淡帶黃橙	淡帶橙黃	〃	……黃諸
		全紫	〃	淡紫	無	紡錘形	淡帶赤橙	白	〃	……嶺南四
		全深紫	深紫	淡紫	極少	下膨長紡	淡橙赤	淡帶黃橙	〃	……嶺 No. 36
		綠	〃	〃	〃	下膨紡	濃帶紫赤	白	紫	……嶺 No. 37
直立	心臟形	全淡紫	綠	〃	〃	〃	濃赤	〃	無	……四川種39

	戟形粗鋸齒	綠	深紫	綠	少	下膨長紡	濃帶赤橙	淡橙黃	淡紫	……合川大藤子
	鼻形	周緣淡紫	〃	深紫	中	長紡錘形	濃紫赤	淡帶橙黃	無	……四川種47
	五深裂	全紫	淡紫	紫	少	紡錘形	淡橙黃	淡淡橙黃	〃	……永春五齒
半直立	心臟形	綠	紫	綠	無	〃	淡赤橙	黃橙	〃	……Red Nancy
	三淺裂	〃	淡紫	〃	中	〃	淡紫赤	白	〃	……假英國種
		周緣淡紫	深紫	淡紫	極多	下膨長紡	淡帶黃橙	淡橙黃	淡橙紅	……四川種2
		綠	淡紫	淡紫綠	極少	紡錘形	淡橙	淡橙黃	無	……冲繩100(一)
		〃	深紫	紫	〃	長紡錘形	淡橙黃	白	紫	……嶺南一
	五深裂	〃	深紫	淡紫	中	短紡錘形	淡橙	濃帶赤紫	白	……嶺南二
		全淡紫	〃	紫	多	〃	淡帶黃橙	白	無	……冲繩100(二)
	戟形	周緣淡紫	深紫	深紫	少	紡錘形	濃紫赤	白	紫	……蕃茄芋
		綠	〃	〃	〃	〃	濃赤	白	〃	……嶺No. 6
纏繞	三淺裂	〃	綠	綠	中	長紡錘形	濃赤橙	白	無	……四川種10

「附註」 觀察僅一年而被淘汰之品種未列入此表

（七）結　　論

1. 民國三十五年至三十七年，由江蘇、浙江、四川、福建、廣東及廣西等省，先後引進甘藷品種七十一種，於民國三十七年九月起至四十年四月止，進行觀察調查其各品種之特性。

2. 第一年觀察完畢後，由六十七品種中選出四十二品種，繼續觀察之，其餘除一品種外均悉數予以淘汰，該被淘汰品種皆由四川省與福建省引進者，迨因其無特殊優良性狀可資利用於雜交育種者也。

3. Red Nancy Oklahoma (24) 及冲繩100號三品種，因引進時間過晚，未及於第一年（民國三十七年）種植，於第二年(民國三十八年)起始加入觀察，冲繩100號發現有二種完全不同之性狀，故暫以冲繩100號(一)及冲繩100號(二)命之；經參照過去之記載，冲繩100號(一) 實爲正確者。

4. 由南京中央農業實驗所及福建農事試驗場先後引進，具有同一品種名稱之南瑞苕 (Nancy Hall) 二品種，經第一年觀察結果，認爲二者之各種性狀均相符合無異，確爲同一品種，故於第二年(民國三十八年)起合併觀察之。

5. 引進品種中，大多數爲早熟或近於早熟之中熟種。Nancy Hall, Porto Rico, 嶺南二號及永春五齒等四品種，不但品質優，食味佳，且製簽百分率頗高，堪爲育種之優良親本及供推廣之佳種。嶺南五號，嶺 No. 1 ，嶺 No. 16, 松陽 23, 松陽 41, 松陽 208, 及松陽 243, 號等七品種，雖製簽率很低，但均爲豐產而早熟之品種。

6. 關于甘藷花期及花數，作二年以上觀察之品種，計有四十六品種，其中九品種在嘉義均不開花，其他開花之品種，花數最少者爲 1.3, 最多者竟達 244.5 朵花，其花期與花數，各年均稍有差異，關于開花數，三年間相關係數之平均值爲+0.842。

(N=35　機率1%　　r=0.4182)

(八) 英 文 摘 要

OBSERVATION ON THE CHARACTERISTICS OF RECENTLY INTRODUCED VARIETIES OF SWEET POTATO (IPOMOEA BATATAS)

By

H. Wang

Summary

(1) The characteristics of seventy-one sweet potato varieties introduced from Kiangsu, Chekiang, Szechuang, Kwangsie, Kwangtung and Fukien provinces and other plances during 1946 to 1948 were observed from September of 1948 to April of 1951.

(2) Through the observation in first year, fourty-two out of sixty-seven varieties were selected for successive observation and all but one introduced from Szechuang and Fukien provinces were discarded due to their useless inferior characteristics for cross-breeding.

(3) Three varieties, "Red Nancy," "Oklahoma 24" and "Okinawa 100" which were too late to be planted in 1948, were partaken the observation since 1949. The "Okinawa 100" variety was temperarily divided into two lines, named the "Okinawa 100 (1)" and the "Okinawa 100 (2)" due to the different characteristics of whole plant bodies and "Okinawa 100 (1)" was lately identified to be the true one according to the earlier records.

(4) Two- varieties, one from the Nanking Central Agriculture Research Bureau and the other from the Fukien Agricultural Experiment Station, have a same varietal name "Nancy Hall" and they were lately proved to be the same one at all. They were, therefore, fused in one for observation from second year (1949).

(5) Majority of the introduced varieties are early-maturing or nearly so. These most popular varieties such as "Nancy Hall" "Porto Rico" "Lin Nang No. 2" "Yung Ch'un Five teeth" produce tubers not only suitable for table use but also giving high percentage of chips, so that these may be used for both extension and breeding, while the "Lin Nang No. 5", "Lin No. 1", "Lin No. 16", "Sung Yang No. 23", "Sung Yang No. 41", "Sung Yang No. 208", and "Sung Yang No. 243" although poor in chips, are all early maturing and high yielding varieties.

(6) Out of Fourty-six varieties observed for more than two years on flowering period and flower number, only nine varieties have not flowered at Chia-Yi. Flowers blossomed on the flowered varieties are quite different in number. The range of flower numbers per plant among these varieties is between 1.3 to 244.5. The duration of flowering period and the number of flowers varied more or less in different years. The average of correlation coefficient of flower number in three years was +0.842.

(N=35 P=0.01 r=0.4182)

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